Personality, Obsessive-Compulsive Symptoms, and Human Computer Interactions

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Statement

I declare that this thesis is my own work and that, to the best of my knowledge and belief, it does not contain material from published sources without proper acknowledgment, nor does it contain material which has been accepted for the award of any other higher degree or graduate diploma at any university.

Signed:  Date: 30/6/2001

Harjit S. Bagga

Acknowledgments

This thesis is dedicated with much love, gratitude, and disinfectant to my contamination-concerned family.

I have been extremely fortunate to know the several very special people who have helped me complete this thesis without the need to take potent psychotropic medication. First I would like to thank my 'top class' supervisors Ken Kirkby and Frances Martin for their unfailing support, encouragement, advice, patience, and ideas which have been invaluable (this is *not* a moot point!). Second I would like to thank the fantastic team in the Department of Psychiatry, in particular Lisa "L" Gilroy for her counsel, encouragement, hysterical-laughter sessions, debriefing, data analysis, and helping me learn about Fearmaster(s), and Brett Daniels for his patience, encouragement, and reassurance.

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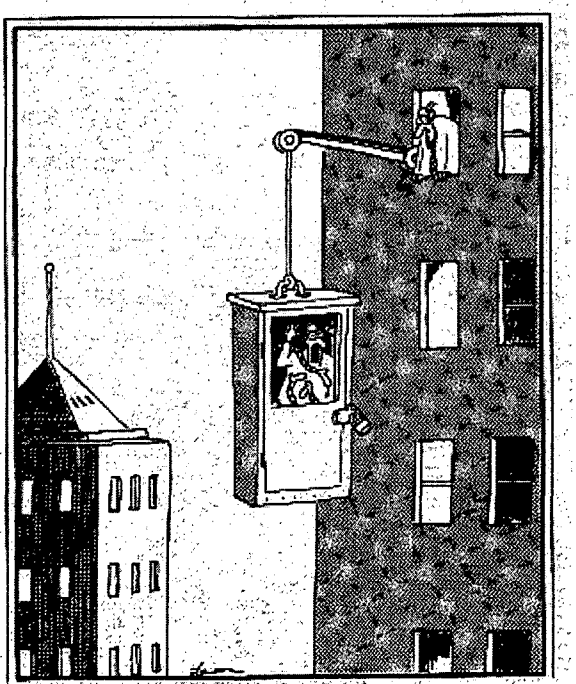

Professor Gallagher and his controversial technique of simultaneously confronting the fear of heights, snakes, and the dark.

This picture has been reproduced from the *Far Side Gallery 3* (1994) by Gary Larson (p. 90). Published by Warner Books, London.

"Face the thing you fear the most and it will be the certain death of it"
- Alfred, Lord Tennyson

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List of Commonly Used Abbreviations

For the purpose of clarity, the abbreviations that frequently appear in this thesis have been included below:

CAVE:	Computer-aided vicarious exposure
FFM:	Five factor model
HCIs:	Human computer interactions
OCD:	Obsessive compulsive disorder
OCPD:	Obsessive compulsive personality disorder
PD:	Personality disorder
SSRIs:	Selective serotonin reuptake inhibitors

Literature Review

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Abstract

The two most commonly used treatments for obsessive-compulsive disorder (OCD) are antidepressant drugs and behaviour therapy in the form of exposure and response prevention. These treatments, while efficacious, have limitations such as high costs, side effects, and limited availability. The use of computers in the therapy process minimises some of the barriers traditional OCD treatments present, while providing benefits in their own right. Evidence suggests that computer-aided behaviour therapy programs may be a suitable adjunct to traditional client-therapist treatments. Computer-aided vicarious exposure (CAVE) programs not only deliver a therapy, but can also measure the interaction between the program user and components of therapy. The availability of computer treatments that can measure these interactions opens the way for research into variables that may influence a user's interaction with a treatment program. Individual personality characteristics are known to impact treatment outcome, however, there is little literature examining the relationship between personality variables and their impact on OCD treatment. Further research into the relationship between personality and OCD treatments, in particular computer treatments which measure user interaction with the program, can assist in identifying the components of therapy useful for people with different characteristics.

Obsessive compulsive disorder (OCD), once thought to be a rare condition, now ranks as one of the most common psychiatric disorders (Pedrick, 2000; Rasmussen & Eisen, 1992). With this recognition, research has been guided into OCD and its treatment. Fortunately, many sufferers can be relieved of the obsessions and compulsions, that characterise this disorder, with treatments currently available.

There are a variety of treatment options available for OCD, ranging from medication, traditional client-therapist behaviour therapy, and the more recent computer-assisted treatments. The success of OCD treatments in alleviating symptomatology, however, is dependent on many variables. These include the personal characteristics of a client. The aim of this literature review is to examine the role that an individual's personality characteristics may have on their interaction with a novel OCD treatment, computer-aided vicarious exposure.

In addressing this aim, a review of literature in several areas will be conducted. First, the diagnosis, nature, epidemiology, and aetiology of OCD will be examined. Second, treatment options for OCD will be reviewed, including traditional interventions, and the recent introduction of computer-aided treatment. Third, the current view of research investigating the relationship between personality and OCD will be discussed. Finally the impact personality characteristics have on OCD treatments will be addressed.

OCD – What is it and How is it Defined?

To assist in distinguishing 'normal' from 'clinical' psychological states, the *Diagnostic and Statistical Manual (4th ed.)* (DSM-IV; American Psychiatric Association [APA], 1994) has been developed. OCD is classified by the DSM-IV as an anxiety disorder, as it has been argued that anxiety is an underlying feature of this disorder. The DSM-IV lists the symptoms of OCD required for a clinical diagnosis. The characteristic features of OCD are the presence of obsessions or compulsions, or both. The DSM-IV defines obsessions as repetitive or persistent thoughts, ideas, impulses, or images that cause marked distress or anxiety. Compulsions can be defined as repetitive behaviours or mental acts that a person feels compelled to perform, often as a means to neutralise or decrease the anxiety caused by obsessions

(APA, 1994). While most people have behaviours that may be perceived as compulsive or obsessive (Rachman & De Silva, 1978) these symptoms in an OCD sufferer can result in significant impairment, distress, and anxiety, and can be time consuming (Pedrick, 2000). The presenting OCD symptoms and subsequent distress and impairment, are the elements that fulfil the diagnostic criteria for OCD.

OCD – a Homogeneous or Heterogeneous Entity?

There is debate as to whether OCD presentations can be considered homogeneous. The issue of homogeneity can impact upon OCD research, its interpretation, and generalisation. For example, if OCD was homogenous in its presentation then comparisons drawn from one OCD sample could be generalised to another. However, if this were not the case then research findings could not be generalised. This latter option would subsequently impact treatment outcome as one treatment regime would not necessarily be suitable for certain symptom presentations.

The current OCD literature indicates that there is symptom variation in OCD presentations. This suggests that OCD may be a heterogeneous disorder. First, there is a range of behaviours that constitute obsessions or compulsions. Obsessions can include behaviours or thoughts relating to contamination, doubt, a need for symmetry, aggressive or sexual impulses, religion, or hoarding. The presentation of compulsions can be equally broad, ranging from washing, checking, counting, symmetry and precision, ordering, arranging, to hoarding (Freeman, 1992; Leckman et al., 1997; Pedrick, 2000). Second, people may present with only obsessions or only compulsions. Arts, Hoodgduin, Schaap, and De Haan (1992) found patients experiencing only obsessions differed in some of their demographic and symptom variables from those with both obsessions and compulsions. Arts et al. suggested experiencing obsessions alone might represent a subtype of OCD. Alternatively this group may be experiencing a less severe form of OCD as the study revealed that those with obsessions alone reported fewer symptoms. Third, it can be common for people to present with more than one obsession or compulsion (Ball, Baer, & Otto, 1996; Freeman, 1992). Finally, OCD often presents with comorbid psychological disorders, such as depression or other anxiety disorders (Freeman, 1992; Pedrick, 2000). In such cases, OCD symptoms are often masked by these other disorders or

there may be symptom overlap between the two disorders. OCD presentations can vary widely according to symptoms expressed, and the demarcation between symptoms of OCD and symptoms of other psychological disorders is not clear. This body of literature intimates that OCD is a heterogeneous disorder.

The diversity of OCD symptoms can be narrowed, as there are common patterns and clusters of symptoms that occur. Some studies suggest that contamination obsessions and handwashing compulsions or rituals are the most common obsessive-compulsive symptom couplet (Freeman, 1992; Pedrick, 2000; Rasmussen & Eisen, 1992). Other studies report that the two most common compulsions are handwashing and checking (Ball, Baer. & Otto, 1996; Rasmussen & Eisen, 1992; Tallis, 1996). With the given range of OCD symptom presentations, albeit with common symptom clusters, it appears that a generic treatment for all OCD presentations may not be suitable. As an alternative, tailoring treatments to meet the needs and characteristics of clients may be a more successful approach to treating OCD.

Who? What? Where? – The Epidemiology & Course of OCD

Little was known about OCD and its prevalence before the growth of epidemiological studies conducted within the past two decades. Once referred to as "the hidden disease" (Bebbington, 1998, p. 2), OCD now ranks as the fourth most common psychiatric disorder (Pedrick, 2000; Rasmussen & Eisen, 1992). Concern regarding the previously 'undiscovered' number of people with OCD rose to the forefront after the results from the National Epidemiological Catchment Area Survey (ECA) findings, which indicated a lifetime prevalence of 2.5% for OCD (Rasmussen & Eisen, 1992). The ECA was one of the largest investigations into the epidemiology of mental disorders, conducted in the USA in the early 1980s. The lifetime prevalence estimates of OCD from other epidemiological studies has a wide range, from a conservative 0.05% to 2.5%, depending upon the epidemiological research tools used (Bebbington, 1998; Freeman, 1992; Pedrick, 2000; Rasmussen & Eisen, 1992). Prevalence rates similar to the ECA findings have been found in Europe, Taiwan, and Africa (Rasmussen & Eisen, 1992), suggesting that OCD is not limited to Western cultures.

The variation in OCD epidemiological findings could result from a number of causes. First, the ECA research has been criticised for the use of lay-interviewers, which may have lead to an overestimation of prevalence rates (Rasmussen & Eisen, 1992). Second, determining and recording the presence of OCD at the point that it causes marked distress and interference in a person's life can be very subjective, eliciting inconsistent results. Third, the use of different assessment measures and diagnostic criteria in studies can also contribute to yielding different results (Bebbington, 1998; Castle, Deale, & Marks, 1995). Finally, it has been noted that often people with OCD symptoms do not seek treatment until their symptoms or the consequences of their symptoms become severe, thus information on those with less severe symptoms may not be captured (Eddy & Walbroehl, 1998; Rasmussen & Tsuang, 1986). Although there is variation in the prevalence rates of OCD found in epidemiological studies, this research has brought OCD to the attention of researchers by highlighting that OCD is more common than was previously thought.

Through these epidemiological studies, trends in OCD onset and course have been shown. The average age of OCD onset is during early adulthood at approximately 19-20 years of age (Bebbington, 1998). Others studies suggest the age of onset typically occurs from early adolescence to early adulthood (Eddy & Walbroehl, 1998; Franklin & Foa, 1998). When it occurs, the onset of OCD is generally gradual, (Franklin & Foa, 1998) with variation in the duration, type, and severity of symptoms; thus the course and prognosis of OCD can fluctuate (Freeman, 1992; Rasmussen & Eisen, 1992).

Epidemiological findings related to gender ratios for OCD have been mixed. The ratios from these findings suggest that the gender ratio is approximately 1 (males) : 2 (females) (Bebbington, 1998). Using both prospective and retrospective data, with a sample of 307 adults in Britain, Noshirvani, Kasvikis, Marks, Tsakiris, and Monteiro (1991) found that early onset of OCD (5 –15 years) was more common in males, and was associated with more checking rituals. Conversely, a later onset of OCD (26-35 years) was more common in females, and was associated with more washing behaviours. Noshirvani et al. concluded that that OCD may present differently in males and females.

What Causes OCD? Examining its Aetiology

As with many psychological disorders, the aetiology of OCD has not been conclusively determined. Thus far, it appears that there are both biological and psychological contributors to the development of OCD.

Biological Influences on OCD Development

Neurological and Neuroanatomical Models

From a neurological perspective those with OCD appear to have a paucity of the neurotransmitter serotonin. This view has been supported by the success that serotonergic-based drug therapy has had on symptom remission in those with OCD (Eddy & Walbroehl, 1998). However, in their review of drug treatment for OCD, Delgado and Moreno (1998) note that a depletion of serotonin in those who have untreated OCD or who are taking medication to maintain adequate serotonin levels does not result in an exacerbation of symptoms. Therefore, low serotonin levels alone is not sufficient to explain the presence of OCD. Instead these authors suggest that neural circuitry, possibly involving serotonin pathways, may be implicated in OCD.

A neuroanatomical basis of OCD may involve increased activity in frontal lobes, basal ganglia, and cingulum in OCD patients (Pedrick, 2000). Such findings should be interpreted with caution, as these neurological anomalies may be a consequence of OCD, rather than its underlying cause. Nevertheless, Freeman (1992) notes that some organic conditions may lead to symptoms of OCD.

Genetic Model

A genetic link or predisposition to OCD development has also been hypothesised by several researchers. Andrews, Crino, Hunt, and Lampe (1994) reviewed some literature based on twin studies and investigations of the first-degree relatives of those with OCD. Andrews et al. reported that there is some evidence to suggest a genetic basis for OCD development. However, it is difficult to draw definitive

conclusions based upon the genetic and biological aetiology of OCD as these factors can be difficult to differentiate from the psychological and environmental variables that contribute to OCD development.

Psychological Influences on OCD Development

Most of the 44 patients with a DSM-III (APA, 1980) diagnosis of OCD, examined in Rasmussen and Tsuang's (1986) research, reported an increase in symptomatology following stressful life events. Pedrick's (2000) OCD review also supports such findings, suggesting that stressful life events may precipitate OCD onset or worsen existing symptoms. However, as the cognitive perspective of OCD's aetiology suggests, it could be the OCD sufferer's perception of these life events, rather than the events themselves that could contribute to the development or exacerbation of OCD symptoms. It is clear that environmental and psychological variables contribute to the aetiology of OCD. Formal psychological theories of OCD have also been posited.

Behavioural Model of OCD

The behavioural model of OCD development suggests that obsessions become the focus of anxiety through learning experiences, such as conditioning. The presence of an obsession causes anxiety, which is reduced by adopting escape or avoidance behaviours (such as hand washing or checking). However, avoidance or escape behaviour reinforces compulsions and prevents exposure to the anxiety-provoking stimulus. Consequently, habituation to the feared stimulus does not occur and the avoidance behaviour(s) are maintained (Brooker, 1982; Salkovskis, Forrester, & Richards, 1998). This theory implies that compulsions are necessary for the causation and maintenance of the disorder. However, as previously noted, in the DSM-IV diagnostic criteria compulsions are not a necessary feature of OCD diagnosis. Other views, such as a cognitive approach to OCD may account for this gap in the behavioural model.

Cognitive Models of OCD

Cognitive models of OCD development have been proposed suggesting that an individual's behaviour results from their cognitive appraisal or interpretation of events. Anxiety manifests in relation to the consequences of being in a particular situation or thinking a particular thought (James & Blackburn, 1995). Examples of common appraisals or interpretations of events for OCD sufferers include danger expectancies (Jones & Menzies, 1997) or an exaggerated or inflated sense of responsibility (Rachman, 1993; Salkovskis, Forrester, & Richards, 1998). A cognitive model may account for the development or maintenance of OCD, but not all OCD sufferers have such cognitive appraisals (Andrews et al., 1994).

Biological and psychological models have been posited to explain the aetiology of OCD. To date, it appears that these influences alone cannot satisfactorily account for all occurrences or presentations of OCD. It is likely that there is a combination of factors in the development and maintenance of OCD as both biological and psychological treatments, based on the proposed aetiology, have been successful in treating OCD.

Treatments for OCD

Up until the mid-1960s OCD was thought to be a disorder very resistant to treatment (Franklin & Foa, 1998). There are now numerous treatment options that are efficacious in alleviating OCD symptoms. This variety of successful treatment options is likely to have arisen from the growing awareness of the biological and psychological influences behind OCD. The most commonly used treatment interventions include medication, psychological therapies, or a combination of both.

Pharmacological Treatments

A range of pharmaceutical agents, such as antipsychotics, benzodiazapines, and antidepressants, have been trialed in the treatment of OCD. Drug treatments have the added advantage of being easy to administer for the prescriber and easy to use for the OCD sufferer. In general, the antidepressant range of drugs has had the most success

in OCD treatment, in particular the newer range of selective serotonin reuptake inhibitors (SSRIs). These drugs inhibit the reuptake of serotonin, increasing its availability. Now SSRIs are the most widely used pharmacological treatment for OCD (Greist & Jefferson, 1998). Commonly prescribed and trialed SSRIs include fluvoxamine, fluoxetine, sertraline, and paroxetine. Other antidepressant medications, such as clomipramine, a tricyclic antidepressant inhibiting the reuptake of noradrenaline and a potent serotonergic agent, have had success in the treatment of OCD. However, clomipramine has a higher incidence of side effects compared with SSRIs (Pigott & Seay, 1999), although a placebo-controlled study comparing clomipramine with SSRIs had the lowest rate of drop-outs in the clomipramine trial (Griest, Jefferson, Kobak, Katzelnick, & Serlin, 1995).

Marks and O'Sullivan (1988) reviewed several studies using clomipramine and fluvoxamine. They found that both drugs reduced depressive, anxiety, and OCD symptoms such as obsessions and compulsions. The reduction in OCD symptoms reported often occurred in relation to improvement with depression. OCD's high comorbidity with depression and other anxiety disorders makes it difficult to differentiate OCD symptom improvement to the drug or from a secondary effect of alleviating depressed mood. It appears that antidepressant drug therapy is an effective treatment for reducing obsessions and compulsions, but also has a broad range of effects, such as improving mood and reducing anxiety, that contribute to alleviating OCD symptoms.

As with all medications, there are potential side effects. Clomipramine has more potent side effects than the newer SSRIs. Adverse effects of clomipramine include anticholinergic effects (such as dry mouth), sedation, sexual dysfunction, weight gain, and considerable toxicity in the event of overdose (Pigott & Seay, 1999). Although SSRIs have fewer side effects than other antidepressants, such as few anticholinergic effects and lower toxicity in overdose, adverse reactions can include nausea, insomnia, restlessness, and weight gain (Pedrick, 2000). The presence of side effects generally begins immediately but symptom remission or reduction starts within 2-3 weeks (Marks & O'Sullivan, 1988). With low doses of SSRIs, side effects are often fewer, and tolerance to these is often developed. However, once symptom improvement has occurred, medication needs to be continued indefinitely as relapse

rates upon cessation can be as high as 80% for fluvoxamine or 89% for clomipramine as suggested by two studies reviewed by Griest and Jefferson (1998).

Antidepressants, in particular SSRIs, can alleviate OCD and depressive symptoms. In order to maintain maximum benefit, SSRIs would need to be considered as a long-term treatment option to avoid relapse. However, their side effects may limit their use in a number of people.

Behavioural Treatments

Behavioural treatments offer another successful treatment alternative for OCD, but without the side effects caused by medication. The premise of behaviour therapy is to change behaviour by resisting obsessions and compulsions. Behaviour therapy in the form of exposure and response (or ritual) prevention has had well-established success in treating OCD (Dar, 1996). 'Exposure' involves the OCD sufferer deliberately facing their feared or avoided stimulus. The second component, 'response prevention', involves either delaying or preventing compulsions from being carried out. For example a person with contamination obsessions may be asked to place their hands in a bucket of dirt (exposure) and then resist the urge to wash their hands (response prevention). This type of procedure is usually carried out 'live' or in vivo, but can also be imagined, with most people beginning to habituate in the first session (Marks & O'Sullivan, 1988). The procedure of exposure is generally graded and exposure tasks can be varied to attend to the various cues that may trigger unwanted behaviour (Marks, 1986).

Exposure and response prevention, a symptom-directed therapy traditionally involving collaboration with a therapist, can be tailored to meet individual needs according to symptom presentation. The therapist may need to be involved in the early sessions of exposure and response prevention, but thereafter may taper their involvement to providing support and encouragement for the client.

A review of OCD treatment outcome literature by Franklin and Foa (1998) revealed that approximately 75% of OCD sufferers treated with behaviour therapy experienced a reduction in their symptoms. In a brief review of behaviour treatment

Andrews et al., (1994) noted that long-term treatment gains have been reported with approximately 78% of OCD sufferers maintaining treatment gains after an average of three years following behaviour therapy. There is variation in reported treatment gains. Hand (1998) noted that the range of reported success rates for behaviour therapy varies from 50 – 80% of cases, depending on factors such as research design, intensity and duration of therapy, or measurements of 'success'.

Although treatment gains, in terms of remission of symptoms and long term impact, have been made there are some disadvantages of behaviour therapy. First, exposure and response prevention can be unpleasant for some clients, as it can be very difficult to have to deliberately face what you fear! A great amount of effort and motivation is required on the part of the client to begin and continue with treatment, and it may take weeks or months to complete a treatment program. Second, side effects of exposure and response prevention, such as discomfort or anxiety during the process of exposure, can sometimes develop into intense experiences of anxiety or lead to nightmares, however these experiences do tend to remit without intervention (Marks & O'Sullivan, 1988).

Cognitive Treatments

Few studies have been conducted examining the cognitive treatments for OCD. James and Blackburn (1995), conducting a review of cognitive treatments for OCD, reported that three cognitive therapy techniques were generally used. First, challenging obsessional thoughts, for example challenging irrational beliefs. Second, thought stopping, for example, saying aloud the word "Stop!" to disrupt obsessional thoughts. Finally, challenging negative automatic thoughts that accompany obsessional thoughts. On their examination of 15 controlled and non-controlled empirical studies, drawn from a literature search, there was an overall reduction in OCD symptoms. However, it should be noted that (1) only five of the 15 studies was controlled and (2) all these studies examined multiple cognitive treatments. This makes it difficult to extrapolate the effectiveness of specific cognitive techniques in treating OCD.

Emmelkamp and Beens (1991) conducted a study comparing exposure and response prevention in vivo with rational emotive therapy (RET). Both treatment groups experienced partial symptom remission, but there were no significant differences between these two groups. However, in the second last phase of treatment, the RET group also received exposure in vivo, which makes it difficult to conclusively attribute symptom reduction to each treatment. Nevertheless, it was noted that those in the RET group had significantly fewer irrational beliefs at the conclusion of the study.

Van Oppen et al. (1995) also conducted a study comparing exposure and response prevention in vivo with cognitive therapy (primarily identifying, challenging, and changing irrational thoughts). Both treatments led to significant improvement in OCD symptoms, however differences in effect size and the percentage of those who had recovered was greater for those who undertook cognitive therapy. These results along with the findings of Emmelkamp and Beens (1991) indicate that cognitive therapy may be an efficacious treatment for OCD in its own right, or as an adjunct to exposure in vivo. However, the literature on cognitive therapy for OCD is limited. Presently, exposure and drug therapy have been the most researched and are consequently the more commonly used and preferred treatment options for OCD.

Pharmacological and Psychological Therapies Combined

Behaviour therapy, in the form of exposure and response prevention, and drug therapy, combined or used independently, are the treatment modalities of choice for OCD. There are side effects for both drug therapy and exposure and response prevention; however, Marks and O'Sullivan (1988) note that most people are able to accept these side effects. Based on these authors clinical practice, they note that approximately 25% of clients refuse or drop out of exposure therapy, which is comparable to the rate for drug therapy.

Several studies have examined the role and efficacy of both drug and behaviour therapy combined. Simpson, Gorfinkle, and Liebowitz (1999) used behaviour therapy as an adjunct to treating five OCD patients who continued to experience symptoms of OCD after an adequate trial on SSRIs. Although the sample was very

small and all patients had a comorbid DSM-IV Axis I disorder, all attained significant symptom improvement after exposure and response prevention.

Similar results were obtained in a study examining the efficacy of two treatment conditions in the remission of OCD symptoms: (1) fluvoxamine and behaviour therapy (i.e., exposure and response prevention), compared to (2) behaviour therapy and placebo drug, (Hohagen et al., 1998). The results for this sample of 49 patients with OCD showed that both treatment conditions led to a significant reduction in OCD symptoms. Further, obsessions and depressive symptoms decreased significantly more in those receiving fluvoxamine combined with behaviour therapy. Although approximately 50% participants respectively met the criteria for a comorbid Axis I disorder, and a comorbid personality disorder, this study supports the notion that medication (fluvoxamine) and behaviour therapy combined can result in significant OCD symptom reduction. However, SSRIs may have a larger role to play in OCD treatment in reducing certain symptoms, particularly when there are comorbid depressive symptoms.

Van Balkom et al. (1998) conducted a study comparing cognitive therapy (identifying and challenging irrational thoughts, behaviour therapy (exposure and response prevention) and drug therapy (fluvoxamine). Five treatment groups were created among their sample of 117 with OCD: cognitive or behaviour therapy alone, cognitive or behaviour therapy combined with fluvoxamine, or control (wait list). Although fluvoxamine alone was not used as a comparison group, and no placebo was used for either the cognitive or behaviour therapy groups, the results showed a significant decrease in OCD symptoms for all treatment groups in comparison to the control group. However, there was no significant difference between each treatment group, suggesting that all treatments examined were equally effective in symptom reduction. This finding is in line with Hohagen et al.'s (1998) results indicating that psychological treatments combined with behaviour therapy can be used successfully to alleviate OCD symptomatology.

Van Balkom et al.'s (1998) results are also consistent with the findings of Van Balkom et al. (1994), who conducted a meta analysis using 86 studies between 1970 – 1993 to examine outcome research on the behavioural, cognitive, and

antidepressant treatments for OCD. There was an overall trend for treatment gains made with all active treatments when compared to placebo. Looking specifically at self and assessor rated OCD symptom measures, the treatments with significant treatment gains compared to placebo controls were serotonergic antidepressants, behaviour therapy, and serotonergic antidepressants combined with behaviour therapy. This highlights that the two most efficacious treatments for OCD are antidepressants with serotonergic properties and behaviour therapy.

Individually and in tandem, there is evidence to suggest that behaviour therapy, in the form of exposure and response prevention, and antidepressant medication (specifically, SSRIs) are effective in the reduction of OCD symptomatology. When used together, SSRIs come into the fore by assisting with the remission or reduction of depressive features, which may subsequently impact the reduction of OCD symptoms. However, exposure and response prevention appears to have a superior long-term outcome when compared to drug therapy, with fewer somatic side effects.

An Innovative Approach to Behaviour Therapy – Using Computers

Behaviour therapy alone or combined with drug treatment, in its traditional client-therapist format has produced successful results in symptom reduction for many people with OCD. However, psychological intervention, for example, exposure and response prevention with a therapist, has several drawbacks. First, therapists are scarce. According to Marks (1992) the demand for behaviour therapy exceeds resources thus minimising the access of behaviour therapy with a therapist to a limited few. Second, there is the cost associated with seeing a therapist for treatment, and for many this may be too great (Greist, 1989). Third, research has shown that often those with OCD are reluctant to seek treatment because of shame or embarrassment about their symptoms (Rassmussen & Eisen, 1992). Finally, there are those who are unable to access resources limited by either the nature of their illness or geographic isolation. For example, a client diagnosed with contamination obsessions and who fears leaving their house in case of contamination may not be physically able to access services due to the very nature of their affliction.

The high cost, lack of therapists, and a difficulty or inability to access traditional client-therapist interaction limits access to treatment for many with OCD. One way to improve the availability of OCD treatment may be to use computers as a therapy tool. Plutchnik and Karasu (1991) highlight that "computers are economical, consistent, with a perfect memory, and no moral judgements" (p. 39). Using computers in the behaviour therapy process may be useful in overcoming some of the barriers of therapist-client interactions with the potential to bring additional benefits not available in traditional interactions.

Computers in Therapy

While a fairly recent innovation, computers in psychotherapy appear to have useful and varying roles. In their review of literature pertaining to computers and therapy, Plutchik and Karasu (1991) examined some of the roles computers can adopt and their efficacy in these positions. For example, in the role of an 'interviewer', such as conducting a diagnostic interview, computers were effective as a data gathering tool. A study by Klepsch (1990) found that eight out of ten OCD patients preferred answering questions about their OCD symptomatology on computer, rather than using a pen and paper questionnaire, suggesting that computers can be used as a tool of convenience by both clients and practitioners. Plutchick and Karasu found that patients responded positively to computers, in particular during the gathering of sensitive material. This is likely to be due to the privacy and anonymity computers offer. With tentative conclusions being drawn, based on the limited literature, Plutchick and Karasu found support for computers used as a therapeutic tool in the therapy process.

Computers and Their Role in Behaviour Therapy for OCD

Computers in a therapy situation, at the present time, are not an adequate replacement for a therapist. Indeed, there are many attributes necessary for clinical practice that a computer does not have, such as making clinical judgements outside of programmed or set instructions and scenarios (Plutchick & Karasu, 1991). As an alternative to traditional client-therapist behaviour therapy, computers may be used as an adjunct or as part of exposure and response prevention. Marks (1992) points

out that one of the key components of exposure therapy is *self*-exposure, suggesting that the need for therapists during the entire treatment process is not necessary. Similarly, Greist (1989), who reviewed literature on computer-administered behaviour therapy, specifies that behaviour therapy is a treatment that people learn with an emphasis on self-help. Several computer programs have been developed adopting this focus. Rather than replacing a therapist, computer assisted behaviour therapy programs have the potential to be a useful adjunct to other available treatments.

Greist (1989) reported that behaviour therapy-based computer programs developed to treat disorders that respond to traditional behaviour therapy interventions such as phobias, depression, and autism, achieved treatment gains at a level equal to or above that obtained by therapists. This leaves room for computer programs designed to treat OCD.

A single case study design reviewing the use of a portable computer program in a female with obsessive thoughts and checking rituals was reported by Baer, Minichiello, Jenike, and Holland (1988). The client consulted the program, 'OC-CHECK', when she felt the need to and after enacting her rituals. The program provided instructions and feedback, for example instructions to resist the urge to check for three minutes were given, or reminders that no negative consequences would ensue if she did not check. OC-CHECK stored information such as the intensity and frequency of urges and actual checking. The client was provided with daily feedback about the number of checking behaviours performed. After 49 weeks, the records showed that the client's intensity to check decreased in line with her decreased checking rituals. Follow up at 91 weeks confirmed low levels of checking behaviour. Albeit a single case design, this study demonstrates the successful use of computers as a feedback and monitoring tool in exposure therapy.

The development of 'BT-STEPS' reported by Baer and Greist (1997) presents another innovative use of computer technology in the exposure and response treatment of OCD. BT-STEPS was designed as a self-help tool using a telephone as a point of contact. Interactive voice response (IVR) allowed digitised voice files from a computer to be sent through telephone lines to the client. Clients could respond to

questions via a telephone keypad. The BT-STEPS program comprised nine steps, covering the triggers of obsessions and rituals specific to the user, a personalised treatment plan of exposure and response prevention with specific goals and objectives, and feedback on progress. Participants were able to make contact with a clinician via voice messages.

A comparison on the use of BT-STEPS in three study sites (Boston and Madison, USA and London, England) found positive results (Marks, et al., 1998). Using a self-help BT-STEPS manual and BT-STEPS, participants with OCD completed a self-assessment and devised a personalised exposure treatment plan. The results of this study showed that 64% of participants successfully completed a self-assessment examining the severity of their OCD and the impact of their symptoms. It was found that those who completed the self-assessment more quickly subsequently performed more sessions of self-exposure. This consequently resulted in a decrease in OCD symptomatology.

A follow on to the study by Marks et al. (1998) was conducted by Bachofen et al. (1999). This latter study used a British sample with participants receiving written or verbal praise by a clinician alongside BT-STEPS. In line with the findings of Marks et al., a majority of participants completed a self-assessment of their symptoms. The 10 participants who progressed to the exposure and response prevention component of BT-STEPS had a significant reduction in OCD symptomatology. Compared to the study by Marks et al., more rapid progress was made in the Bachofen et al. study. However, this may be attributable, in part, to the encouragement offered by the clinician.

Both the BT-STEPS and the one-off OC-CHECK programs appear to work as successful adjuncts to self-exposure, with some clinician involvement. Another approach to computers in therapy, is in a computer program designed to deliver vicarious exposure and response prevention in an interactive, symbolic format or Computer-Aided Vicarious Exposure (CAVE) (Clark, Kirkby, Daniels, & Marks, 1998). This program reported by Clark et al., involved participants applying the principles of exposure and response prevention through a figure, on-screen, depicted as having contamination obsessions and handwashing rituals. After undergoing three

45-minute treatment sessions, there was a significant reduction in OCD symptomatology experienced by the 13 participants with OCD. Those with primarily washing compulsions had the greatest symptom reduction compared to those who had checking compulsions. This program also permitted an analysis of participant's behaviour on the program. Across the three treatment sessions, participants undertook actions of exposure and response prevention more quickly, indicating that they had understood the principles of exposure and response prevention. Albeit with a small sample, vicarious exposure and response prevention as presented on a computer appears to have viability in reducing OCD symptoms.

Further analyses of participant's behaviour on CAVE were conducted with Clark et al.'s (1998) sample (Kirkby et al., 2000). CAVE allowed measurement of participant's behaviour on the program, by examining human computer interactions (HCIs). The results of this study indicated that over the three treatment sessions, participants increased the amount of vicarious exposure they conducted and decreased their ritualisation behaviour. Further, increased exposure activity predicted OCD symptom reduction. These findings suggest that not only can computers be used as a treatment for OCD, but can also provide useful information regarding the behaviours enacted by program users, which may not be as easy to measure in a traditional client-therapist situation.

From the literature to date, there is capacity for computers to be used in the treatment of OCD, whether as an adjunct to self-exposure or as a mechanism for vicarious exposure. Each of these methods has produced significant treatment gains in terms of symptom reduction, with or without direct clinical involvement. Further to this potential as a treatment, as seen in CAVE (Kirkby et al., 2000), computers provide the unique opportunity to measure and record many variables while a treatment program is being undertaken. Such information may not be as readily available in a therapist-client interaction. Depending on their programming, computers have the potential to measure the interaction between a client and the computer treatment or HCIs. Such information can be valuable in determining the components of therapy that are useful for making treatment gains, how people with different characteristics interact with a program, and ultimately which types of therapy are best suited to people with different characteristics.

Influences on Treatment - Personality

The manner in which people interact with treatments, whether in a traditional client-therapist setting or a computer interaction, can be influenced by many things. For example, in spite of its usefulness in treating OCD, not all clients respond equally well to traditional therapist-client behaviour therapy. The influences on treatment are numerous. However, several researchers examining influences on treatment outcome have found variables, for example personality, that may be one of the (many) contributors to treatment response (see Black & Noyes, 1997; Miller, 1991; Reich & Green, 1991).

Personality Research

'Personality' is a term used both clinically and in daily language. There are however, three main difficulties that arise when studying personality. First, as Watson, Clark, and Harkness (1994) note the study of personality in a systematic way is difficult. In clinical research as it has been argued that personality is too complex to study in a scientific manner and that current research is confusing and complicated. Indeed finding a standard definition of personality is not straightforward! For the purpose of clarity, the broad definition put forward by Pervin (1993) who suggests that "personality represents those characteristics of a person that account for consistent patterns of behaviour" (p. 3) will be adopted. Third, there is not a universally agreed-upon theory of personality for personality research to work within. This can impact the way personality is measured and subsequently the interpretation of research may vary. However, a current and popular view of personality, is the 'trait' approach to the study of personality. Pervin (1993), suggests that traits are "...the fundamental units of personality, representing broad dispositions to respond in particular ways" (p. 306). Finally, the approach to studying personality is not universally agreed upon. Personality may be studied and viewed as either a categorical or dimensional entity. The categorical view, adopted by the DSM-IV, for example, holds that personality disorders are discrete diagnostic categories and a diagnosis is given with either the presence or absence of a personality disorder. The extent to which a personality disorder may be present or the degree to which a personality style may be

maladaptive is not considered, as it would be in a dimensional view (Widiger & Frances, 1994).

The study of personality is complex. With no universally agreed upon means of studying personality, clinical research using personality is varied, difficult to compare and difficult to draw consistent conclusions from. Nevertheless, with the onset of standardised measures and criteria couched in specific theories of personality, consistency and ease of interpretation in personality research is being attained.

DSM-IV Categorical Measures of Personality: Personality Disorders

Adopting a categorical approach, the DSM-IV outlines the criteria for disorders, providing standardised guidelines for clinical practice and research. To address the presence of maladaptive personality types the category of "personality disorders" has been developed. Although personality disorders have been documented by the DSM-IV, these disorders and their diagnostic criteria are debatable (Widiger & Frances, 1994). The DSM-IV groups the personality disorders (PDs) into three clusters: Cluster A (odd or eccentric behaviour), Cluster B (dramatic, erratic or emotional behaviours), and Cluster C (anxious or fearful behaviour). Obsessive compulsive personality disorder (OCPD) falls into this last category. OCPD differs from OCD as it lacks the defining features of OCD - obsessions and compulsions. Characteristic features of OCPD include perfectionism, high levels of conscientiousness, inflexibility, and a preoccupation with details or order (APA, 1994). Although features of OCD and OCPD may overlap, and some may present with symptoms of both disorders, the existence of a clear relationship between these two disorders is not conclusive.

OCD and Categorical Measures of Personality

Most studies examining the relationship between OCD and personality have used categorical measures of personality, such as PD, rather than adopting a dimensional view of personality traits. Early research on personality and OCD (e.g., Rosenberg, 1967; Sandler & Hazari, 1960) typically examined personality characteristics of what

we now refer to as OCPD. Couched in psychoanalytic theory, 'obsessional neurosis' was generally viewed as part of a spectrum alongside 'anal' or obsessional personality traits. It was held that obsessional personality traits were precursors to the development of obsessional neurosis. With earlier research, the lines between obsessive-compulsive symptoms, and obsessive personality traits were often blurred, making interpretation difficult. With the advent of clearer diagnostic criteria for obsessive-compulsive symptoms and personality in the more recent editions of the DSM, and the use of structured interviews or self-report questionnaires based upon such criteria, interpretation of more recent research into OCD and personality is a little clearer.

Recent investigations into OCD and OCPD suggest that a relationship between the two disorders is not clear cut. Pollack (1987) conducted a review examining this relationship. His examination of clinical opinion and empirical research found that while there are similarities between these two disorders OCPD is not a requisite feature for the development of OCD. This suggests that OCPD and OCD are not on a continuum of development, and instead represent two conceptually different entities. Indeed, OCD has been associated with DSM-IV PDs other than OCPD. Black and Noyes (1997) conducted a more recent review of OCD and its relationship with general PDs. They found that while some people with OCD had OCPD traits, few met the full diagnostic criteria of OCPD. Second, they found that at least a third of those diagnosed with OCD had a comorbid PD, often from Cluster C.

Several studies using the same instrument to measure PDs and OCD symptoms, obtained conflicting results. Using the Personality Diagnostic Questionnaire (PDQ), a self rating scale to assess the presence of DSM-III (APA, 1980) PDs, and the Maudsley Obsessional-Compulsive Inventory (MOCI) a self-rated scale assessing obsessional symptoms, Mavissakalian, Hamann, and Jones (1990a, 1990c) examined the relationship between OCD and PDs. Approximately 50% of their two independent OCD samples were diagnosed with at least one PD. The most common comorbid PD diagnosis was avoidant PD (Cluster C), with other PD diagnoses or traits predominating from this cluster, including OCPD. Comorbid PD diagnoses and PD traits did cover the gamut of PDs from Clusters A – C. These results nevertheless did not demonstrate an exclusive relationship between OCD and OCPD.

Conversely, Rosen and Tallis (1995) and Tallis, Rosen, and Shafran (1996), respectively using a non-clinical and clinical sample found a specific relationship between OCPD and OCD. Both studies also used the revised version of the PDQ, (PDQ-R) as their measure of PD and the MOCI to determine OCD symptoms. Rosen and Tallis used a non-clinical student sample to eliminate confounds arising from comorbid anxiety or depressive features. First, they found that a surprisingly high two-thirds of their 83-student sample met the criteria for a PD. Although the PDQ is known for eliciting a high number of false positives, the prevalence of PD diagnoses was still higher than expected. Second, when Rosen and Tallis included anxiety and depression effects there were significant correlations between OCD symptoms and the range of PDs, in line with previous research. However, upon the removal of anxiety and depression effects, only OCPD was significantly correlated with OCD symptoms. Tallis et al. obtained similar findings with their clinical sample (n = 77). Obsessional symptoms were correlated with a range of PDs. However, after controlling for anxiety and depressive symptoms, OCD symptoms were significantly correlated with OCPD and passive-aggressive personality traits (a Cluster C PD). These findings highlight that the presence of PDs in those with OCD is common. However, other anxiety or depressive features may mask the presence of comorbid OCPD in those with OCD.

Studies have also examined the relationship between PDs and Axis I anxiety disorders including OCD, panic disorder with or without agoraphobia and generalised anxiety disorder (Mavissakalian, Hamann, Haidar, & De Groot, 1993; Mavissakalian, Hamann, & Jones, 1990a; Sciuto, et al., 1991). Between one-third to two-thirds of participants in these three studies had a comorbid PD diagnosis, predominantly from Cluster C, but again ranging from Clusters A – C. Rather than demonstrating a specific relationship between PDs and these three anxiety disorders, the findings suggest an associated or common personality structure for these anxiety disorders. The predominant comorbid PD diagnosis from Cluster C is indicative of anxious or fearful personality types. This has intuitive value, as the basis for these Axis I disorders is anxiety, and thus anxiety-related personality types would not be unexpected.

A high percentage of people diagnosed with OCD also meet the criteria for a comorbid PD, though not necessarily OCPD. This pattern appears to be present in other anxiety disorders. The high proportion of PD diagnosis reported in the aforementioned studies has typically risen from only one form of diagnostic evaluation, such as a self-rated questionnaire (e.g., PDQ or PDQ-R). Only Sciuto et al. (1991) used a structured interview. It has also been noted that the PDQ elicits a high rate of false-positives. Best practice in clinical settings often espouses the use of more than one instrument to formulate a diagnosis. Thus an over-estimation of PD prevalence may have been reported. Alternatively, a high incidence of reported PDs could be attributed to problematic construct validity of the diagnostic categories themselves (Costa & Widiger, 1994).

Relationships between PDs and OCD or any other Axis I disorder need to be interpreted with caution when premorbid personality and symptomatology is unknown. Several implications can be drawn from such research. First, a certain personality disorder may be a precursor to the development of an Axis I disorder. Second, an Axis I disorder may bring with it characteristics or behaviours that resemble PDs. Finally, as suggested by Hyler and Frances (1985), the presentation of an Axis I *and* Axis II disorder may share an underlying aetiology, or may merely be coincidental. Thus the interrelationships between OCD and OCPD or other PD can be very complex.

OCD and Dimensional Personality Traits

Few studies have examined the relationship between OCD and dimensional personality traits. Several theories have been developed that view personality as a dimensional concept (see Watson et al., 1994). As such several models have been developed that consider general personality traits. The currently accepted models may use different labels, but all seem to define or adhere to a similar structure (Watson et al., 1994). The "Big Five" or the five factor model (FFM) is a widely accepted model that outlines a taxonomy of personality traits in five broad dimensions: (1) neuroticism (or emotional instability), (2) extroversion, (3) openness to experience (or 'intellect'), (4) agreeableness (or friendly compliance), and (5) conscientiousness (or dependability or willingness to achieve) (Costa & Widiger,

1994; Watson, et al., 1994). Each of these broad factors can be broken down into more specific traits to provide a clearer picture of an individual. This structure of personality traits has been widely tested with different conditions and populations (Watson et al., 1994).

With its relationship to psychopathology, neuroticism is often a trait underlying the anxiety and depressive disorders (Watson et al., 1994) and has been shown to have a positive relationship to OCD and OCD symptoms (Clark, Watson, & Mineka, 1994; Pollack, 1987). Using a three-factor model of personality traits (neuroticism, extroversion, and psychoticism), neuroticism was a significant predictor of the discomfort associated with OCD symptoms in an Australian university student non-clinical sample (Scarrabelotti, Duck & Dickerson, 1995).

Several studies have examined the relationship between the categorical PDs and dimensional personality as represented by the FFM. Using the self-rated NEO Personality Inventory (NEO-PI), a personality inventory measuring the traits of the FFM, and several PD measures, including the PDQ-R, Trull (1992) found that the FFM factors account for both 'normal' and 'abnormal' (PD) personality features. Using an outpatient sample, Trull found that neuroticism was a feature of most PD presentations including OCPD. Low levels of extroversion were also associated with OCPD. OCPD, when measured by the PDQ-R and structured interview, was also negatively correlated with agreeableness. Widiger, Trull, Clarkin, Sanderson, and Costa (1994) suggested that OCPD could generally be associated with characteristics of the FFM including neuroticism, low extroversion, and conscientiousness.

Costa and McCrae (1990), using a non-clinical sample, reported similar findings when comparing the NEO-PI results with PDs measured by the Minnesota Multiphasic Personality Inventory (MMPI) and PDs measured by self-report on two versions of the Millon Clinical Multiaxial Inventory (MCMI-I and MCMI-II). Neuroticism, low extroversion, and low agreeableness were associated with compulsive PD (seen to be equivalent to OCPD) according to self reports on the NEO-PI, but not on the spouse or peer NEO-PI ratings. In line with other literature, and what would be expected based on the way an obsessional personality is defined, there was a strong positive correlation between conscientiousness and compulsive

PD. However, low scores on neuroticism and openness were associated with Compulsive PD, but this was only significant for the MCMI-I. These findings were not consistent with the general literature nor with findings comparing the NEO-PI and MMPI. The authors attributed this difference to different wording in the PD questionnaires and the subsequent impact of the NEO-PI factor loading related to the different PD measures.

Dimensional and categorical personality measures can provide a comprehensive picture of an individual's personality. The relationship between the FFM personality traits and OCD suggest that neuroticism may be an underlying trait for those people who have OCD or OCD symptoms. Neuroticism also appears to underlie many forms of psychopathology, including some of the personality disorders. The relationship between the FFM and OCPD is unclear. It is likely that traits of neuroticism, low extroversion, and by the nature of the OCPD definition, conscientiousness are associated with OCPD. Although there does not appear to be a direct relationship between OCD and OCPD there is some overlap in the underlying personality traits present in these two conditions.

Personality and OCD Treatment

As proposed earlier, personality variables may impact upon treatment. How do the current personality findings relate to the treatment of OCD? There is some evidence to suggest that the presence of a comorbid personality disorder, i.e., a maladaptive personality style with an anxiety disorder, often results in less responsive treatment (Clark, Watson, & Mineka, 1994; Reich & Green, 1991). In Reich and Green's review of PDs and treatment outcome, they concluded that in relation to OCD, the presence of a PD predicted poorer treatment outcome over a range of treatments including antidepressants (not including SSRIs), and psychotherapy. Definitive statements about specific personality traits that predict poorer outcome were not made due to a paucity of literature. Nevertheless, trends showed that neuroticism predicts poorer outcome in the treatment of anxiety or depressive disorders. In a recent study several personality changes occurred in both an OCD and clinically depressed sample after a SSRI course (Brody et al., 2000). Of the sample of OCD patients (n = 17), those who responded to treatment (n = 8) had a decrease in factors

contributing to personality traits referred to as 'harm avoidance' and 'hostility', which are akin to neuroticism. An increase in 'social dominance' or 'social confidence' (likened to the FFM extroversion), common to the administration of SSRIs was also found. In a study of 27 patients with OCD treated with clomipramine, Mavissakalian, Hamann, and Jones (1990b) found a reduction in maladaptive personality type (i.e., PDs), however, many maladaptive personality traits were still present post-treatment.

In terms of psychological treatment for OCD, information on personality plays a role. Collins and Thompson (1993) posit that the use of personality assessment information may be useful in formulating a treatment program as information on personality can help to predict behaviour. For example, Fals-Stewart and Schafer (1993) examined compliance with exposure and response prevention in a large OCD outpatient sample. Using the MMPI, they found that certain personality variables such as social introversion (or low extroversion in FFM terms) predicted missed sessions of behaviour therapy. This suggests that other forms of therapy, such as drug therapy may be more appropriate for those with introverted characteristics. Such information may help streamline therapy for individuals.

Miller (1991) examined the advantages of having an understanding of personality traits and their impact on treatment, based on his own clinical experience and the literature. He identifies three ways in which an understanding of a client's personality can benefit clinicians: (1) personality profiles provide clinicians with an understanding of the client's experiences, needs, and feelings, (2) this provides a framework to understanding their presenting problems, and (3) in turn this knowledge can be used to develop a treatment plan for the client, with the ability to predict difficulties the client may have with treatment. Based on the NEO PI results of his own clients, over a two-year period, Miller drew clinical and statistical conclusions about the relationship between client personality traits and psychological treatment. To summarise, he found that (1) neuroticism influenced the intensity and duration of distress experienced by the client, (2) extroversion influenced enthusiasm for the process of treatment and expressiveness within treatment, (3) openness influenced reactions toward treatment intervention, (4) agreeableness influenced

reactions toward the therapist and (5) conscientiousness was associated with willingness to do the work required in therapy.

It appears that knowledge of a client's personality traits can provide a treating clinician with information about how a client may respond to treatment intervention, whether it is drug or psychological therapy. The FFM may be a useful tool to predict these behaviours.

Few studies have been conducted that specifically examine the role of personality and behaviour therapy outcome in OCD. Steketee (1990) examined the relationship of PDs and exposure and response prevention outcome in a sample (n = 26) of OCD patients. Over one-third of participants met the criteria for at least one PD, covering the gamut of PD clusters (i.e., no specific relationship between OCD and OCPD). All participants experienced a significant reduction of OCD and depressive symptoms. When comparing treatment gain, there was no significant difference between those that did and did not meet the criteria for a PD. These results contrast the consensus in the literature which posits that the presence of a PD does impact upon treatment, generally (see Clark, Watson, & Mineka, 1994; Reich & Green, 1991). However, the small sample size may have reduced the statistical power necessary to detect differences between the PD and non-PD groups. Scarrabelotti et al. (1995) briefly reviewed literature examining personality traits and the specific components of exposure and response prevention for OCD. Their review included literature that suggests that the obsessions and compulsions of those scoring high on measures of introversion (i.e., low extroversion) and neuroticism were more resistant to extinction and thus slow to habituate during behaviour therapy (exposure and response prevention).

The literature on personality and behaviour therapy is sparse with a PsychLit search revealing only one study that has examined the effect of personality and response to CAVE (Harcourt, Kirkby, Daniels, & Montgomery, 1998). This study used a sample of 18 participants diagnosed with agoraphobia, treated with a CAVE program delivering vicarious exposure to elevators. Personality was measured using the NEO-PI as a measure of the FFM of personality. Unexpectedly, low agreeableness scores were correlated with improved treatment outcome measured by a reduction in

anxiety behaviours and reduction in agoraphobic cognitions. Further analyses of the relationship between personality and behaviour on the vicarious exposure computer program was examined, using the same sample and measures (Kirkby, Daniels, Harcourt, & Romano, 1999). Using data measuring Human Computer Interactions (HCIs), correlations between NEO-PI factors and HCIs were performed. Higher neuroticism scores were correlated with behaviours akin to avoidance, openness was associated with less exposure activity but more exploration of the program, and conscientiousness was positively correlated with exposure behaviours. This study demonstrates first, that computers can be successfully used to breakdown the steps and analyse particular components of behaviour therapy. Second, meaningful data can be obtained from this information when combined with personality variables. Finally, personality variables do show some relationship with the way individuals interact with a computer program simulating vicarious exposure.

The relationship between personality and HCIs on a CAVE program for OCD has not yet been established. HCI and personality research, as demonstrated by Kirkby et al. (1999), can provide insight into how people with different characteristics, such as personality traits, respond to treatment programs. This has the potential for tailoring treatment to best suit the needs of the individual client, minimising time and financial costs for both the client and therapist.

Summary and Conclusions

The current pharmacological and behavioural treatments available for OCD are efficacious in alleviating OCD symptomatology. Using computers as an adjunct to the treatment of OCD offers additional advantages to present treatments. First, programs such as CAVE can be accessed more easily than traditional therapist-client treatments. Second, HCIs between the client and treatment can be easily measured, assisting in identifying the components of therapy that are useful for making treatment gains.

It has been acknowledged that certain personality features underlie or are associated with OCD, such as Cluster C PDs and neuroticism traits. Further to this, individual personality characteristics influence response to treatment. There is presently little

research examining the relationship of dimensional personality traits and treatment outcome in OCD. HCIs, as measured by CAVE, provide the unique opportunity to identify the strategies people use in a treatment program. Examining interactions between client personality traits and therapy, such as the HCIs in CAVE, can assist in determining which components of therapy are best suited to people with different characteristics.

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Empirical Study

An Exploration into Personality, Obsessive-Compulsive Symptoms, and Human Computer Interactions

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Abstract

This study investigated the relationship between measures of personality and interaction on a computer-aided vicarious exposure (CAVE) program in a student sample experiencing high and low levels of obsessive compulsive disorder (OCD) symptoms. The personality variables of interest included the five factor model (FFM) traits and symptoms of obsessive compulsive personality disorder (OCPD). Students were selected on the basis of their scores on a measure of OCD symptoms, forming a high and low OCD symptom group; 23 participants were in the high OCD symptom group and 21 in the low OCD symptom group. Results indicated that participants in the high and low OCD symptom groups did not differ significantly in their interaction with CAVE, nor in their scores on personality traits or symptoms of OCPD. Trends suggest that the experience of comorbid personality disorder symptoms, particularly from Cluster C were common in this student sample, regardless of OCD symptoms. Likewise, higher conscientiousness scores were consistently associated with ritualisation behaviours on CAVE regardless of OCD symptomatology, likely to be an expression of fastidious behaviour. The findings from this study suggest that CAVE allows for the efficient measurement of both user interaction with this treatment program and the associated relationships between user personality characteristics and components of treatment.

Obsessive compulsive disorder (OCD) can be treated with some success using behaviour therapy in the form of exposure and response prevention. This treatment has been traditionally undertaken with a therapist but within the past two decades, research has been conducted incorporating computers in the therapy process as an alternative or adjunct to traditional behaviour therapy (see Greist, 1989). The development of computer-aided vicarious exposure (CAVE) treatments also facilitates measurement of the way people learn and interact with specific components of exposure therapy. Information regarding the way people use a treatment program may be useful in determining which therapies, or components of therapy are useful for people with different characteristics.

There is a plethora of research examining general treatments and treatment outcome for OCD. However, there is a paucity of literature that examines how people with different characteristics engage in exposure and response prevention specific to OCD. By using a CAVE program for OCD information regarding the interactions between a program user and treatment can be easily elicited and measured. It is of interest, in the present study, to examine the relationship between personality characteristics of a CAVE user, and their interaction with the program.

The *Diagnostic and Statistical Manual (4th ed.)* (DSM-IV; American Psychiatric Association [APA], 1994) specifies that a diagnosis of OCD requires the presence of obsessions, compulsions, or both. Obsessions are defined by the DSM-IV as repetitive or persistent thoughts, ideas, impulses, or images that cause marked distress or anxiety for the sufferer. Compulsions are defined by the repetitive behaviours or mental acts that a person feels compelled to perform, often to neutralise or decrease the anxiety resulting from obsessions. The experience of behaviours that can be likened to obsessions and compulsions is common in the general population (Rachman & DeSilva, 1978), however for a clinical diagnosis of OCD the DSM-IV specifies that obsessions and compulsions must cause significant impairment and distress to the individual.

There is wide variation in the presentation of OCD symptoms. Obsessions can constitute behaviours or thoughts related to a range of concerns such as contamination, doubt, sexual impulses, or religion. Compulsions can be equally varied, including washing, checking, and counting (Freeman, 1992; Leckman et al., 1997; Pedrick, 2000). Not only is there variation in the type of symptoms expressed, OCD often presents with comorbid psychological disorders, such as depression or other anxiety disorders (Freeman, 1992; Pedrick, 2000). This mesh of symptoms can often mask symptoms specific to OCD and, in some cases, symptoms may overlap between OCD and the comorbid disorder(s). There are, however, some symptoms that tend to be more prevalent among those with OCD. For example, the most common obsession-compulsion couplet is contamination obsessions and handwashing rituals (Freeman, 1992; Pedrick, 2000; Rasmussen & Eisen, 1992). Research indicates that handwashing and checking are the two most common compulsions (Ball, Baer, & Otto, 1996; Rasmussen & Eisen, 1992; Tallis, 1996). When looking at treatment options for OCD the diversity in OCD presentation and characteristics that can influence treatment outcome need to be considered. Rather than finding one treatment for all OCD presentations, determining which treatment or components of treatment best suit an individual may assist in obtaining optimum treatment gains for clients.

The two most common treatments for OCD are antidepressants and behaviour therapy. Serotonergic antidepressants, such as selective serotonin reuptake inhibitors (SSRIs) (e.g., fluvoxamine) or tricyclic antidepressants (e.g., clomipramine) are commonly used to treat OCD. Findings vary, but approximately 40 – 60% of people respond to antidepressants with a reduction in OCD symptoms (Rauch & Jenike, 1998). Antidepressants tend to have broad effects, as they not only reduce OCD symptoms, but also alleviate symptoms of depression and anxiety (Marks & O'Sullivan, 1988). The known comorbidity OCD has with depression makes it difficult to attribute OCD symptom improvement to the drug or to a secondary effect of improvement in mood.

Although OCD symptoms can decrease, there are two main disadvantages of drug treatment that limit its use. First, antidepressants such as SSRIs have side effects

including nausea, insomnia, restlessness, and weight gain (Pedrick, 2000). Second, drug treatment in OCD often needs to be continued as a long term treatment option as upon cessation, relapse rates can be as high as 80% or 89% as reported in two studies reviewed by Greist and Jefferson (1998). This can limit the use of drug treatment to those who can tolerate side effects over the long term.

An alternative, and also successful, treatment for OCD is behaviour therapy (Dar, 1996). In the form of exposure and response prevention, this therapy aims to change behaviour by encouraging clients to resist obsessions and compulsions. There are two components of this therapy: (1) exposure, involving facing the feared or avoided stimulus, and (2) response prevention, which involves delaying or preventing compulsions from being carried out. Treatment gains have been positive. A review of OCD treatment outcome literature by Franklin and Foa (1998) revealed that approximately 75% of OCD sufferers treated with behaviour therapy experienced a reduction in their symptoms. Long term treatment gains have also been reported, with approximately 78% of OCD sufferers maintaining treatment gains after an average of three years following behaviour therapy (Andrews, Crino, Hunt, Lampe, & Page, 1994). Disadvantages of behaviour therapy include the anxiety and discomfort experienced during exposure which, in some cases, may lead to nightmares or general anxiety. However these 'side effects' tend to remit without intervention (Marks & O'Sullivan, 1988).

Exposure and response prevention can be viewed as superior to antidepressants as long term treatment gains are evident upon the cessation of treatment and there are fewer somatic side effects. Unfortunately, not everyone is able to access traditional exposure and response prevention with a therapist. The high cost, limited resources, and difficulty accessing traditional client-therapist services (Greist, 1989; Marks, 1992) warrants the development of resources that can overcome these limitations. The innovative use of computers as a resource in therapy situations may minimise the barriers that current treatments present, while providing additional benefits in their own right (Plutchnik & Karasu, 1991).

Several computer treatments have been developed in the treatment of OCD with positive treatment results (Bachofen et al., 1999; Baer, Minichiello, Jenike, & Holland, 1988; Clark, Kirkby, Daniels, & Marks, 1998; Marks et al., 1998). For example, the computer-aided vicarious exposure (CAVE) program reported by Clark et al. was designed to deliver vicarious exposure and response prevention in an interactive format, with an on-screen figure depicted as having contamination obsessions and hand washing rituals. After three 45-minute sessions, all 13 participants with OCD, experienced a significant reduction in their symptoms. CAVE was particularly effective for participants with contamination obsessions and washing compulsions, compared to those with checking compulsions.

CAVE also permitted the unique analysis of human computer interactions (HCIs), which measure the interaction between program users and specific components of the program. For example, in the first session of CAVE, Clark et al. (1998) found that participants with OCD conducted less exposure than controls. Analyses of HCIs on CAVE were conducted with Clark et al.'s sample by Kirkby et al. (2000), who found that over three treatment sessions, participants increased the amount of vicarious exposure they conducted and decreased their ritualisation behaviour. Further, increased exposure activity predicted OCD symptom reduction. Such a breakdown of a program user's behaviour in a treatment program would be difficult to undertake in a traditional client-therapist setting. Having this information readily available highlights the areas of program use or participant behaviour that are useful for making treatment gains.

In spite of the success of behaviour therapy, there are numerous impacts upon treatment outcome including the personality of treatment users (see Black & Noyes, 1997; Miller, 1991; Reich & Green, 1991). Early research into personality and OCD held that obsessional personality traits were precursors to the development of OCD symptomatology (e.g., Rosenberg, 1967; Sandler & Hazari, 1960). Most recent research follows a categorical approach to examining personality and OCD by assessing the comorbid presence of obsessive compulsive personality disorder (OCPD) or other personality disorders (PDs) (Black & Noyes, 1997). The DSM-IV groups the personality

disorders into three clusters: Cluster A exemplified by odd, eccentric behaviour, Cluster B characterised by dramatic, erratic or emotional behaviours, and Cluster C, identified by anxious or fearful behaviour, such as OCPD. Unlike earlier findings, recent results demonstrate that the relationship between OCPD and OCD is not a clear one. Pollack (1987) conducted a review examining this relationship and concluded that although there are similarities between the two disorders, OCPD is not a requisite feature for the development of OCD. Indeed much research has found that PDs associated with OCD cover the spectrum of PDs, with a trend toward comorbid Cluster C PDs, which includes OCPD (Black & Noyes, 1997; Mavissakalian, Hamann, & Jones 1990a, 1990b).

However, using the same measures as Mavissakalian, Hamman and Jones (1990a, 1990b) (the Personality Diagnostic Questionnaire, PDQ, and Maudsley Obsessional-Compulsive Inventory, MOCI) Rosen and Tallis (1995) and Tallis, Rosen, and Shafran (1996) independently found a specific relationship between OCD and OCPD. Using a non-clinical student sample, Rosen and Tallis first found that two-thirds of their sample ($n = 83$) met the criteria for a PD, which is surprisingly high even when the PDQ-R is known for its high rate of false positive diagnosis. Both Rosen and Tallis and Tallis, Rosen, and Shafran, using a clinical sample, found that when anxiety and depression effects were included OCD significantly correlated with a range of PDs. Upon removal of these effects, OCD symptoms were correlated only with either OCPD (Rosen & Tallis, 1995) or OCPD and passive-aggressive PD (Tallis, Rosen & Shafran, 1996).

The research to-date indicates that any examination of the relationship between OCPD and OCD may be obscured by comorbid anxiety or depressive symptoms. It appears that PDs generally, and in particular from Cluster C, can co-occur with OCD and OCD symptoms. These relationships between PDs and OCD need to be interpreted with caution, particularly when premorbid personality and symptoms are unknown. Not only is the construct validity of the PD diagnostic categories problematic (Costa & Widiger, 1994) but certain PDs may be a precursor to the development of an Axis I disorder or an Axis I disorder may bring with it characteristics that resemble PDs (Hyler & Frances, 1985).

An alternative way of examining personality and OCD is to adopt a dimensional view of personality traits. This approach provides an overview of personality function, rather than being limited to discrete diagnostic categories of pathological personality, such as PDs. The five factor model (FFM), a widely accepted model of dimensional personality traits outlines five broad dimensions of personality: (1) neuroticism (or emotional instability), (2) extroversion, (3) openness to experience (or 'intellect'), (4) agreeableness (or friendly compliance), and (5) conscientiousness (or dependability or willingness to achieve) (Costa & Widiger, 1994; Watson, Clark, & Harkness, 1994). Neuroticism is a trait that often underlies anxiety and depressive disorders (Watson et al., 1994), and has been shown to have a positive relationship with OCD and OCD symptoms (Clark, Watson, & Mineka, 1994; Pollack, 1987). Likewise, Widiger, Trull, Clarkin, Sanderson, and Costa (1994) suggested that OCPD could be associated with FFM traits such as neuroticism, low extroversion, and conscientiousness.

This research indicates that neuroticism is an underlying trait for those with OCD or OCD symptoms, and OCPD. But how do current personality findings relate to the treatment of OCD? Miller (1991), based on his clinical experience and the literature, identified the impact dimensional FFM traits could have on psychological treatments, in general. He found that (1) neuroticism influenced the intensity and duration of distress experienced by the client, (2) extroversion influenced enthusiasm for the process of treatment and expressiveness within treatment, (3) openness influenced reactions toward treatment intervention, (4) agreeableness influenced reactions toward the therapist, and (5) conscientiousness was associated with willingness to do the work required in therapy. This suggests knowledge of a client's personality traits can provide a treating clinician with information about how a client may respond to treatment intervention. Thus the FFM may be a useful tool to predict behaviour in treatment.

There is a paucity of personality literature specific to OCD treatment, but findings generally suggest that a comorbid PD with an anxiety disorder results in less responsive treatment (Clark et al., 1994; Reich & Green, 1991). Steketee (1990) found contrasting results when looking specifically at behaviour therapy and PDs. Using a sample of OCD

participants (n = 26) Steketee found there were no significant differences in treatment gain between those who did and did not meet the criteria for a PD. However, the small sample size may have reduced the statistical power necessary to detect differences between PD and non-PD groups.

Although the literature in this area is sparse, it appears that personality does impact an individual's response to traditional behaviour therapy. Scarrabelotti et al. (1995) included literature in their brief review, which suggested that the OCD symptoms of those with low extroversion and high neuroticism traits were more resistant to extinction and slow to habituate during exposure and response prevention. A PsychLit search revealed that only one study has examined the relationship between personality and a CAVE treatment. Harcourt, Kirkby, Daniels, and Montgomery (1998) used a CAVE program for agoraphobia, (simulating vicarious exposure to elevators), to treat 18 participants with agoraphobia. FFM personality traits of participants were measured using the revised NEO Personality Inventory (NEO PI-R). Unexpectedly, low agreeableness scores were correlated with improved treatment outcome measured by a reduction in anxiety behaviours and reduction in agoraphobic cognitions. Further analyses of the relationship between personality and HCIs measuring specific components of therapy were conducted using the same sample (Kirkby, Daniels, Harcourt, & Romano, 1999). Higher neuroticism scores were correlated with behaviours akin to avoidance, openness was associated with less exposure activity but more exploration of the program, and conscientiousness was positively correlated with exposure behaviours. This study, and the findings of Kirkby et al. (2000) using CAVE for OCD, indicate that computers can be used to breakdown the steps and analyse particular components of behaviour therapy. Second this information can be used to determine the actions that participants undertake in treatment, which is difficult to measure in traditional client-therapist interactions. Finally, different personality variables do appear to impact how individuals interact with a computer program simulating vicarious exposure for agoraphobia. Information on how people with different personality characteristics interact with a treatment program can assist in developing treatment strategies tailored to meet the individual user.

The aim of the present exploratory study is to examine the relationship between FFM personality variables, symptoms of OCPD, and HCIs in a single session of CAVE for OCD, in a sample experiencing non-clinical OCD symptoms. By using a non-clinical student sample, potential confounds resulting from comorbid disorders such as depression can be minimised. It is hypothesised that:

1. Participants with high OCD symptoms will have higher scores on the personality measures of neuroticism and OCPD.

2. Those with fewer OCD symptoms will have a higher degree of vicarious exposure interaction with the CAVE program.

3. Low scores on neuroticism and high scores on extroversion, openness, agreeableness, and conscientiousness will be associated with more exposure activity.

Method

Participants

Participants for this study were recruited from a pool of undergraduate students undertaking first year psychology at the University of Tasmania, Hobart campus. These students were screened for OCD symptomatology, using the Padua Inventory – Revised (PI-R). From this sample, 178 students returned a correctly completed PI-R. Of this group, 100 students obtaining the top 50 scores (high OCD symptoms) and lowest 50 scores (low OCD symptoms) were contacted three months later to be recruited for the study. Exclusion criteria included those with an inability to use a standard computer interface and those taking concurrent psychotropic medication. From the sample of 100 students approached, 44 students were recruited, with 21 participants (9 males, 12 females) in the low OCD symptom group (hereafter referred to as "low OCD group"), and 23 (3 males, 20 females) in the high OCD symptom group (hereafter referred to as "high OCD group"). The mean PI-R score for the high OCD group was 77.65 (*SD* =

13.19), and the low OCD group had a mean PI-R score of 45.10 (*SD* = 2.93). The mean age of the low OCD group was 24.67 years (*SD* = 9.32) with a range from 18 – 48 years. The mean age of the high OCD group was 18.70 years (*SD* = .97) with a range from 18 – 22 years. Participation was voluntary, and participants received course credit for their participation.

One participant, in the low OCD group, was taking concurrent psychotropic medication (a benzodiazapine). This participant had been on a consistent dose for at least 6 months prior to being involved in the study, and was therefore included. A second participant from the low OCD group met the criteria for a 'suspect questionnaire' on the *Personality Diagnostic Questionnaire Version 4+* (PDQ-4+), by endorsing one of the two questions on this validity scale. According to the PDQ-4+ 'Instructions for Use' (Hyler & Loh, 1998), this suggests this participant may have been either lying, responding randomly or not taking the questionnaire seriously. Nevertheless, this participant was included in the study as endorsement of the suspect questionnaire item was congruent with other items endorsed on the PDQ-4+ alongside the scores and non-violated validity checks on the *Revised NEO Personality Inventory* (NEO PI-R).

Materials and Apparatus

Each participant completed the assessments outlined below.

Demographic Information

A *Personal Data Sheet* (Appendix A) was created to obtain participant's demographic information, assess the presence of any medical or psychological conditions and subsequent treatment and computer mouse experience using the *Computer Mouse Experience Scale*. This scale elicits a subjective measure of the respondent's experience with a computer mouse on a scale of 1 = "none" to 10 = "a lot".

Measures of IQ and Depression

The *National Adult Reading Test* (2nd edition) *(NART)* (Nelson & Willison, 1991) elicits an estimate of the respondent's Full Scale IQ (FSIQ), based on the ability to read aloud a list of 50 irregular words that do not follow the common rules of pronunciation. The NART is a reliable and valid measure of estimated FSIQ (Nelson & Willison, 1991).

The *Beck Depression Inventory II (BDI-II)* (Beck, Steer & Brown, 1996) is a 21 item self-report scale, measuring the severity of depression. The BDI-II measures the symptoms of depression as stated in the DSM-IV (APA, 1994). Each item is rated on a 0-3 Likert scale. Good reliability and validity has been reported for the BDI-II for both student and clinical samples (Beck, Steer & Brown, 1996).

Assessment of OCD Symptoms

The *Padua Inventory – Revised* (Burns, Heortge, Formea, & Sternberger, 1996) is composed of 39 self-rated items that gauge the presence of OCD symptoms (obsessions and compulsions), and the degree of disturbance these symptoms cause. Each item is rated on a 5-point Likert scale, from 1 = "not at all" to 5 = "very much". The PI-R has five content dimensions that measure specific symptoms of OCD, these are: (1) obsessional thoughts about harm to self/others (Thoughts of Harm), (2) obsessional impulses to harm self/others (Impulses to Harm), (3) contamination obsessions and washing compulsions (Contamination/Washing), (4) checking compulsions (Checking) and (5) dressing/grooming compulsions (Dressing)[1]. Burns et al. have shown that the PI-R has good reliability and validity. For example, the good test retest reliability over a 6-7 month period reported (Burns et al., 1996) was consistent with the reliability of the original Padua Inventory (PI), developed by Sanavio (1988). The PI-R was developed in response to the finding that the original PI obsessional subscales measured the construct of worry. Discriminant validity of the PI-R supported a satisfactory and discernible distinction between worry and obsessions in the PI-R (Burns et al., 1996). The PI was

[1] The PI-R content dimension descriptions in parenthesis are those used by Clark, Kirkby, Daniels, & Marks (1998).

designed for clinical and non-clinical groups and as such as been successfully used to measure the OCD symptomatology of both these groups (Van Oppen, Hoekstra, & Emmelkamp, 1995).

Diagnosis of OCD

The *Composite International Diagnostic Interview-Auto (CIDI-A)* Version 2.1, is a self-rated computerised diagnostic interview to establish the presence of OCD according to DSM-IV (APA, 1994) criteria (World Health Organisation, 1997).

Personality Measures

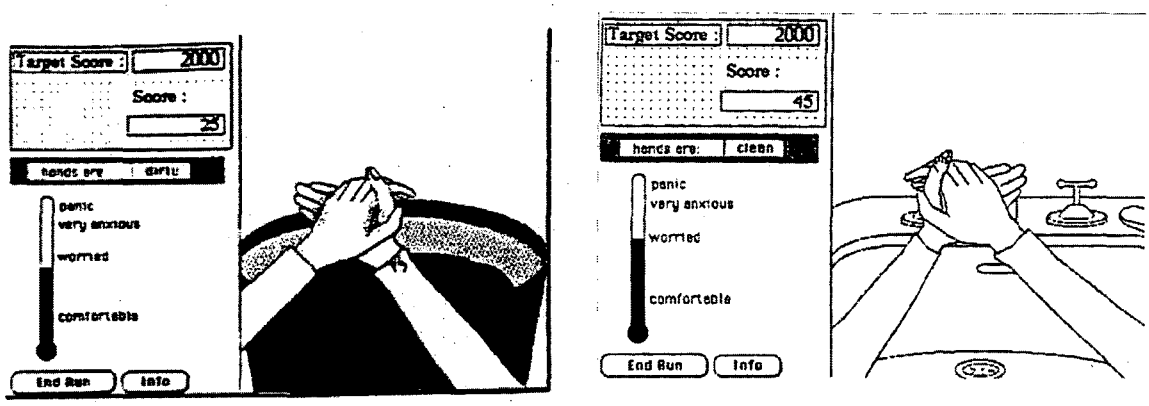
The *Revised NEO Personality Inventory* (NEO PI-R) Form S (Costa & McCrae, 1992) is a 240 item self-rated scale measuring the five domains of the five factor model (FFM) of personality: (1) neuroticism, (2) extroversion, (3) openness, (4) agreeableness, and (5) conscientiousness. Each item is rated on a five- point Likert Scale (strongly disagree – strongly agree). Scores are obtained for each of the five factors or domains of personality, as well as scores for each of the six traits or facets that define each factor. For the purpose of the present study, only scores on the five factors of personality were of interest. Raw scores for males and females are independently compared to non-clinical normative data, with scores on factors and facet scales being interpreted as either "very high, high, average, low, or very low" in comparison to norms. Although only non-clinical normative data is available in the NEO PI-R, the original NEO PI has been successfully used with both clinical and non-clinical samples (McCrae, 1991). Validity and reliability measures of the NEO PI-R are good (Costa & McCrae, 1992).

The *Personality and Diagnostic Questionnaire – 4 (PDQ-4+)* (Hyler & Loh, 1998) is a 99 item self-rated dichotomous True/False scale that assesses the 10 PDs of the DSM-IV (APA, 1994) and two PDs (passive-aggressive PD, and depressive PD) which appear in the DSM-IV appendix. The total number of items that need to be endorsed to obtain a diagnosis of a given personality disorder varies from four to five items. OCPD, the personality disorder of interest in this study, requires the presence of at least four

symptoms to qualify for an OCPD diagnosis. This recent edition of the PDQ differs from its predecessors (the PDQ and PDQ-R) in that it follows the diagnostic criteria of the DSM-IV, and the wording and presentation of questions has changed for ease of answering and to improve validity (Hyler & Loh, 1998). It should be noted, however, that like its predecessors the PDQ-4+ might elicit a high rate of false positive results (Hyler & Loh, 1998).

Computer Treatment Program

Computer-Aided Vicarious Exposure (CAVE), an interactive computer-aided vicarious exposure program for OCD, was administered on a *Macintosh SE/30* computer. This program is written in HyperTalk language. Participants learn the principles of exposure and response prevention through a figure, on-screen, depicted as having OCD with contamination obsessions and hand-washing rituals. An introduction to the program is presented on the computer, outlining the figure's problem and the principles of exposure and response prevention. Participants must take the figure through a process of ritual prevention in order to reduce the urge to hand-wash after touching dirt. The participant can move the figure through several scenes, using a computer mouse. These include the figure's house, which has a bathroom (with a sink to conduct handwashing), a corridor, and garden (with a bucket of dirt). The figure can be manoeuvred outside their house to a hotel (with several floors, an elevator, and stairwell) and a grocery store. Figure 1 illustrates some of the scenes as depicted in the program. While the participant undertakes vicarious exposure, an on-screen 'thermometer' acts as a gauge of the figure's anxiety, which initially increases when they have not washed their dirtied hands. By maintaining dirtied hands, over time, anxiety decreases simulating habituation. Points accumulate toward a target score of 2000 when the participant conducts activities that promote exposure and ritual prevention. Therefore, the higher the score obtained by the participant, the more enactments of exposure and response they undertook. CAVE automatically records all moves made by participants.



(a) Hands being dirtied (exposure). (b) Hands being washed (ritualisation).

Figure 1. On-screen scenes from CAVE as seen by the user. (Actual size 9 inch diagonal, 640 x 480 pixels).

Recording, Measurement, and Analysis of Human Computer Interactions (HCIs)

The programming of CAVE allows data to be recorded that can replay what appears on-screen and the commands a participant was issuing with the computer mouse at a given time. A participant's moves are recorded for the entire 45-minute duration of the CAVE program. Such data is compiled to form a data file for each participant. The use of Fox Pro database software allows the analysis of HCIs from each data file to be conducted. In CAVE, the measurement of HCIs is based upon indices of specific activity, or sequences of activity. There are four sets of HCIs that are of interest in the present study, which are defined as follows.

1. Exposure

This HCI set constitutes occurrences of behaviour where the participant has manoeuvred the on-screen figure to enact a sequence of hand dirtying with a bucket of dirt in the garden.

2. Response Prevention

Response prevention is calculated by examining the occurrence of moves made by the participant in CAVE with the on-screen figure's hands dirty. For example, this may include taking the figure to the on-screen hotel or grocery store with dirty hands.

3. Ritualisation

This HCI set constitutes occurrences of behaviours where the participant manoeuvred the figure to enact a sequence of hand washing in the bathroom.

4. Avoidance

Avoidance constitutes those occurrences where the participant moved the on-screen figure around CAVE, for example the on-screen hotel, with clean hands.

Further to these four HCI sets, are two summary HCIs, 'total moves' and 'mouse travel', which assist in providing a comprehensive picture of a user's behaviour. 'Total moves' refers to the overall level of computer mouse clicking activity in the program. 'Mouse travel', measures on-screen mouse movement and is an index of making and acting upon a decision.

Procedure

Prior to the commencement of this study, ethical approval was obtained from the University of Tasmania Ethics Committee. All participants who had completed the PI-R were approached for further participation in the study, according to their scores. Two groups were formed, those presenting with a high PI-R score and those with a low score. Participants who agreed to be involved in the study were sent a package containing the NEO PI-R, BDI-II, and PDQ-4+ to complete prior to meeting with the researcher. An Information Sheet (Appendix B) outlining the requirements of the study was given to all participants. A Participant Consent Form (Appendix C) was signed by all those

undertaking the study, giving their informed consent to participate. Following this, participants met with the researcher for 1.5 hours to complete the Personal Data Sheet, NART, CIDI-A, and one 45-minute session of CAVE. After an initial introduction with the researcher to the CIDI-A, participants completed this computerised-interview alone. The researcher then presented participants with the CAVE program and were then left on their own to follow the on-screen instructions, introduction, and the program itself. In the introduction to both the CIDI-A and CAVE, participants were instructed to call on the researcher, in an adjacent room, at any time should they require assistance. All participants were debriefed at the conclusion of their testing session, and any questions arising from the study were answered. The scoring of all pen and paper tests was completed subsequent to the gathering of all data.

Two participants from the low group left CAVE after completing approximately 30-40 minutes of the program stating that they felt bored with the program. The results from these participants were still included as more than 75% of the program had been completed.

Design and Analysis

This study followed a mixed design. The between groups independent variable was the OCD symptom group (high or low). The within groups dependent variables were (1) the measures of "personality", specifically, the five NEO PI-R personality traits (neuroticism, extroversion, openness, agreeableness, and conscientiousness) and OCPD symptoms (as measured by the PDQ-4+) and (2) four HCIs (exposure, response prevention, ritualisation, and avoidance) as measured by CAVE. The relationships between OCD symptoms, and both personality and human computer interactions were assessed using 2-way mixed Analysis of Variance (ANOVA) and correlation analyses, with effects significant at a maximum of $\alpha < .05$.

Data Screening

The only pen and paper measure that had missing data was the NEO PI-R of which some questionnaires had a few missing responses. According to the NEO PI-R manual (Costa

& McCrae, 1992), the number of missed responses was insufficient to render these questionnaires or the resulting personality factor scores invalid. The HCIs were recorded as they occurred on CAVE; thus the resulting HCIs are valid.

The ten dependant variables, composed of the HCIs and personality data, as measured by the NEO PI-R and PDQ-4+, were screened for normality and homogeneity of variance, the two primary assumptions of ANOVA. Calculation of skewness and kurtosis revealed that one HCI, avoidance, had a mild positive skew and kurtosis, violating the assumption of normality (Appendix D). Levene's test of homogeneity of variance revealed that two personality measures, neuroticism and agreeableness, and one HCI, exposure, violated the assumption of homogeneity of variance (Appendix E). According to Keppell (1991), ANOVA's *F*-test is quite robust against violations of normality and homogeneity of variance; thus the data were not transformed to obliterate these ANOVA violations.

Data Transformation

The raw scores from the NEO PI-R were transformed into z-scores to account for differences in score interpretation resulting from different normative data for each sex. The NEO PI-R manual (Costa & McCrae, 1992) provided the mean and standard deviation for each personality factor score obtained by males and females in the normative group. Each raw score was transformed into a z-score using the sex-appropriate normative data.

Results

Description of the High and Low OCD Groups

Demographic Information

There was an unequal distribution of males and females for each of the OCD groups, as illustrated in Figure 2. A one-way ANOVA revealed a significant difference between participant's sex and OCD group membership, $F_{(1,42)} = 5.29, p < .05$. There was a greater proportion of females in the high OCD group (63%) compared to the low OCD group (37%). Conversely, there was a greater proportion of males in the low OCD group (75%) compared to the high OCD group (25%). Spearman's correlations between participant's sex and the dependent variables, personality and human computer interactions (HCIs) showed a significant relationship between sex and two of the ten dependent variables (Appendix F). These findings indicated that females enacted more exposure in CAVE than males and had higher scores on conscientiousness. As sex had a significant relationship with only two dependent variables, sex was not treated as a covariate in the remaining analyses.

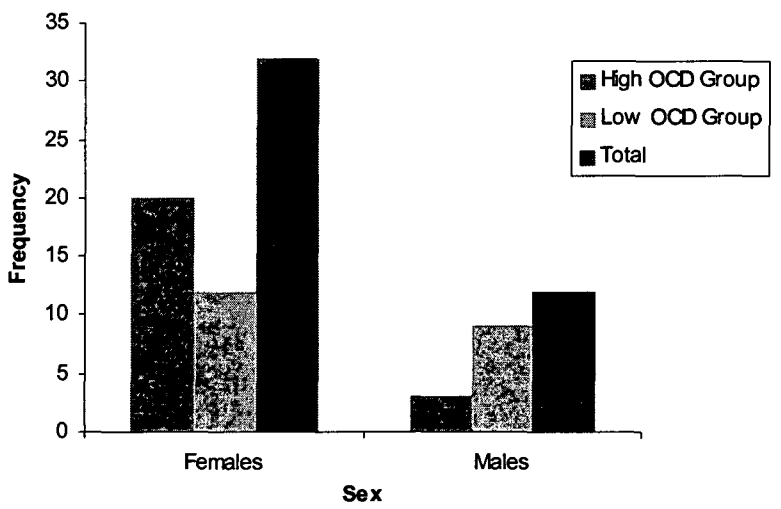


Figure 2. Distribution of male and female participants in low and high OCD symptom groups.

Table 1 presents the mean age, subjective computer mouse experience, BDI-II scores, and estimated Full Scale IQ (FSIQ) of participants in the high and low OCD groups. Participants in the low OCD group were significantly older than participants in the high OCD group, $F_{(1,42)} = 9.34, p < .05$. Pearson correlations between age and the dependent variables of personality and HCIs revealed that age was significantly correlated with only one of the ten dependent variables (Appendix G). A negative correlational relationship was found between age and participant's scores on extroversion, $r = -.49, p < .01$, suggesting that younger participants were less extroverted. As age was significantly correlated with only one dependent variable, age was not treated as a covariate in the remaining analyses.

Table 1

Mean (Standard Deviation) [Range] of demographic information for high and low OCD groups.

	High OCD Group ($n = 23$)			Low OCD Group ($n = 21$)		
Age**	18.70	(.97)	[18-22]	24.67	(9.32)	[18-48]
BDI-II	12.52	(10.24)	[0-23]	7.67	(6.37)	[0-44]
FSIQ*	111.65	(5.08)	[99-123]	115.00	(3.87)	[105-121]
Mouse Experience	8.91	(1.20)	[6-10]	8.38	(1.60)	[5-10]

* $p < .05$, ** $p < .01$

The mean scores for mouse experience and the BDI-II, presented in Table 1, were not significantly different between the high and low OCD groups. A one-way ANOVA revealed a significant difference between the estimated FSIQ scores for the high and low OCD groups, $F_{(1,42)} = 5.96, p < .05$. This indicates that mean FSIQ for those in the low OCD group was higher than the FSIQ for the high OCD group. A Pearson correlation between estimated FSIQ and the 10 dependent variables revealed no significant relationships (Appendix G), as such FSIQ was not treated as a covariate.

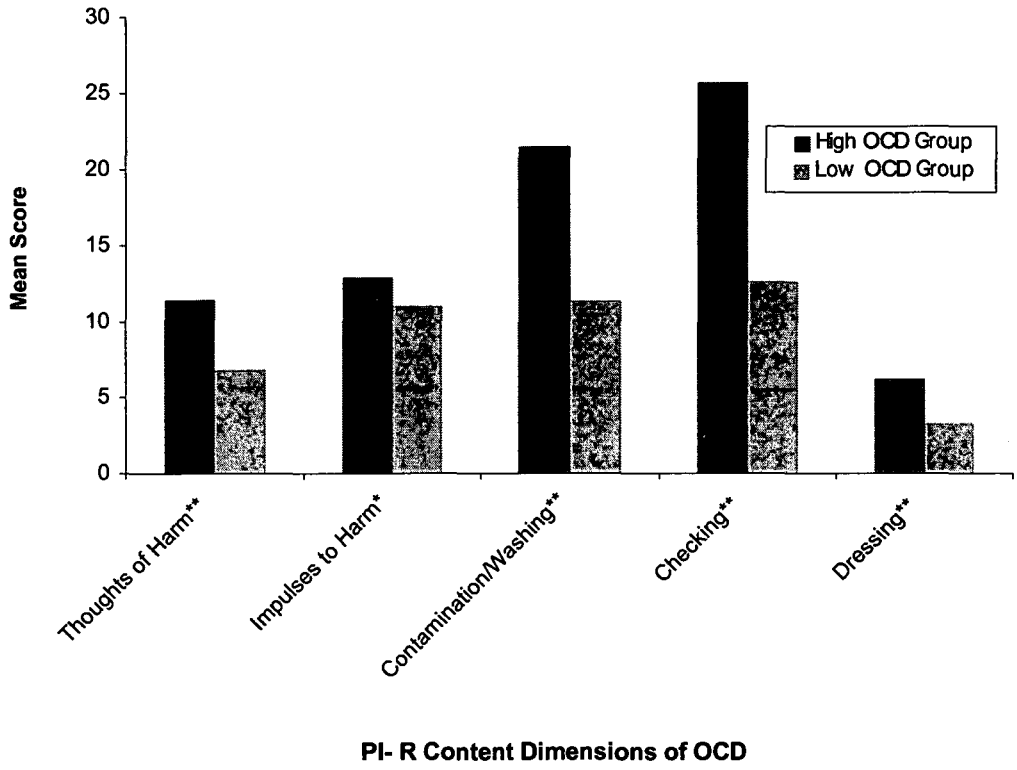
OCD Symptoms

A one-way ANOVA confirmed that the mean PI-R score for the high OCD group (M = 77.65, SD = 13.19) was significantly higher than the low OCD group (M = 45.10, SD = 2.93), $F_{(1,42)} = 122.14$, $p < .001$. The mean PI-R score for the high OCD group is not as high as would be expected for a clinical sample (e.g., Clark, Kirkby, Daniels, & Marks, 1998 reported a PI-R M = 95.3 for their clinical OCD sample). Nevertheless, the high OCD group's mean PI-R score is higher than would be expected for a non-clinical sample (e.g., Clark et al. reported a PI-R M = 46.8 for their non-clinical sample). The mean PI-R score obtained by the low OCD group would be expected for a non-clinical sample.

The five content dimensions of OCD available on the PI-R were examined: (1) obsessional thoughts about harm to self/others (Thoughts of Harm), (2) obsessional impulses to harm self/others (Impulses to Harm), (3) contamination obsessions and washing compulsions (Contamination/Washing), (4) checking compulsions (Checking), and (5) dressing/grooming compulsions (Dressing). A repeated measures factorial ANOVA between the five content dimensions and OCD symptom group revealed a significant main effect for the content dimensions, $F_{(4, 42)} = 119.98$, MSE = 11.91, $p < .001$, indicating that there was a significant difference between scores on the PI-R's content dimensions. A significant interaction between OCD group and OCD content dimensions, $F(4, 42) = 21.47$ $p < .001$ indicates that content dimension scores significantly differed between the high and low OCD groups. Post hoc tests using Fishers PLSD test revealed that the mean scores for Thoughts of Harm, Impulses to Harm, Contamination/Washing, Checking, and Dressing were significantly higher for the high OCD group compared to the low OCD group (Appendix H), as illustrated in Figure 3.

Profile of NEO PI-R Personality Dimensions

Figure 4 shows the mean z-scores for each of the NEO PI-R personality variables obtained by the high and low OCD groups. These mean z-scores are derived from comparisons with the NEO PI-R's normative sample.



** $p < .001$, * $p < .05$

Figure 3. PI-R content dimensions for high and low OCD groups.

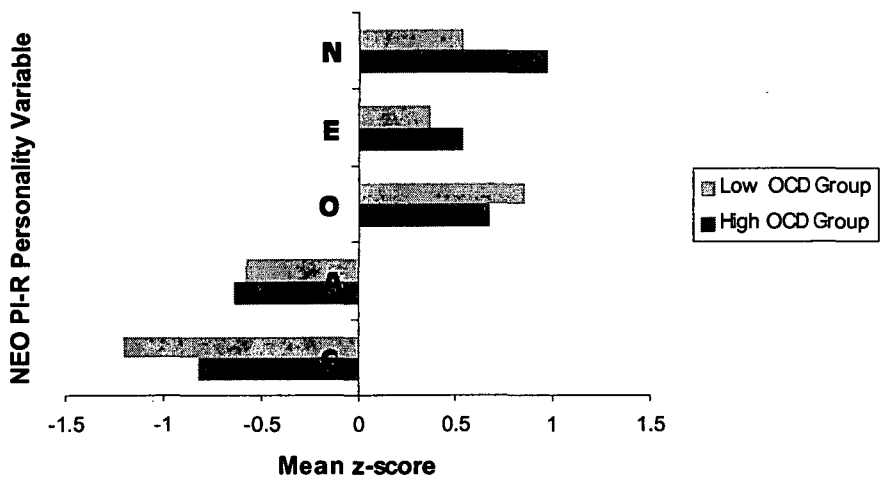


Figure 4. The mean z-score for each of the NEO PI-R personality dimensions for high and low OCD groups. (N, neuroticism; E, extroversion; O, openness; A, agreeableness; and C, conscientiousness).

In comparison to the normative group, the present sample's mean score on all personality traits, except conscientiousness, were within one standard deviation of the mean normative scores. Mean scores on conscientiousness for the low OCD group were below one standard deviation. The mean scores for neuroticism, extroversion and openness for this sample were above average compared with normative sample scores. Conversely, mean scores on agreeableness and conscientiousness were below average compared to the normative group. The high OCD group had higher mean scores on neuroticism, extroversion, and conscientiousness compared to the low OCD group. Traits of openness and agreeableness were higher for the low OCD group.

Profile of PDQ-4+ Personality Disorder Symptoms and Diagnosis

Figure 5 outlines the pattern of personality disorder (PD) symptom endorsement for both the high and low OCD groups. A mixed factorial ANOVA examining PD symptom endorsement between the two OCD groups revealed a significant main effect for PD symptom, indicating that there were differences in symptom endorsement between the PDs, $F_{(11, 462)} = 12.47$, $MSE = 1.64$, $p < .001$. There was no significant interaction between PD symptom endorsement for the two OCD symptom groups, $F_{(11,462)} = 1.47$, $p = .14$. This shows that PD symptom endorsement did not significantly vary between the high and low OCD groups.

Examining the trends of Figure 5, members of the high OCD group endorsed more items relating to all PDs with the exception of antisocial PD. The most common PD symptoms endorsed by both groups were from obsessive-compulsive PD, followed by depressive and borderline PDs. The least frequently endorsed items were those relating to antisocial and schizoid PD. For both high and low OCD groups, symptoms of Cluster C PDs (such as avoidant PD and OCPD) were generally more common.

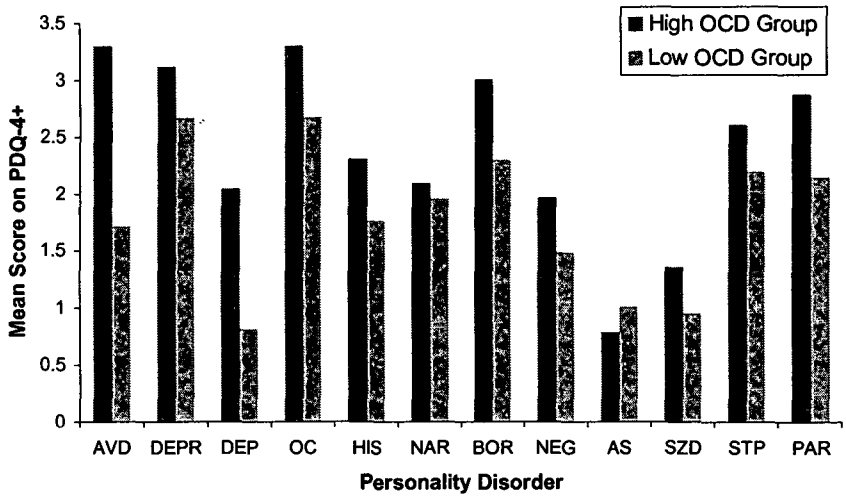


Figure 5. Mean score on each PDQ-4+ PD symptom endorsed for high and low OCD groups. (AVD, avoidant; DEPR, depressive; DEP, dependant; OC, obsessive-compulsive; HIS, histrionic; NAR, narcissistic; BOR, borderline; NEG, negativistic; AS, antisocial; SZD, schizoid; STP, schizotypal; and PAR, paranoid).

In terms of meeting PD diagnostic criteria, Figure 6 displays the frequency of PD diagnosis for high and low OCD groups. The total frequency exceeds the number of participants as some met the criteria for more than one PD. There is a preponderance of people in the high OCD group who meet the criteria for a PD. The most common PD diagnoses for the full sample were obsessive-compulsive (45.45%), avoidant (31.82%), paranoid (27.27%), and depressive (22.73%) PDs. In the high OCD group, over 50% of participant's met the criteria for obsessive-compulsive and avoidant PDs. In the low OCD group, the two most common PDs were obsessive-compulsive (33.33%) and paranoid (23.81%). There is a spread of PD diagnosis across the three PD clusters with the most frequent diagnoses from Cluster C.

The least common PD diagnoses for the sample were for the dependant, antisocial, and histrionic PDs. In the high OCD group, the diagnostic criteria for antisocial, dependant, and narcissistic PDs were the least frequently met. The least common PDs for the low OCD group were depressive, histrionic, and schizoid with no participants meeting the criteria for these disorders.

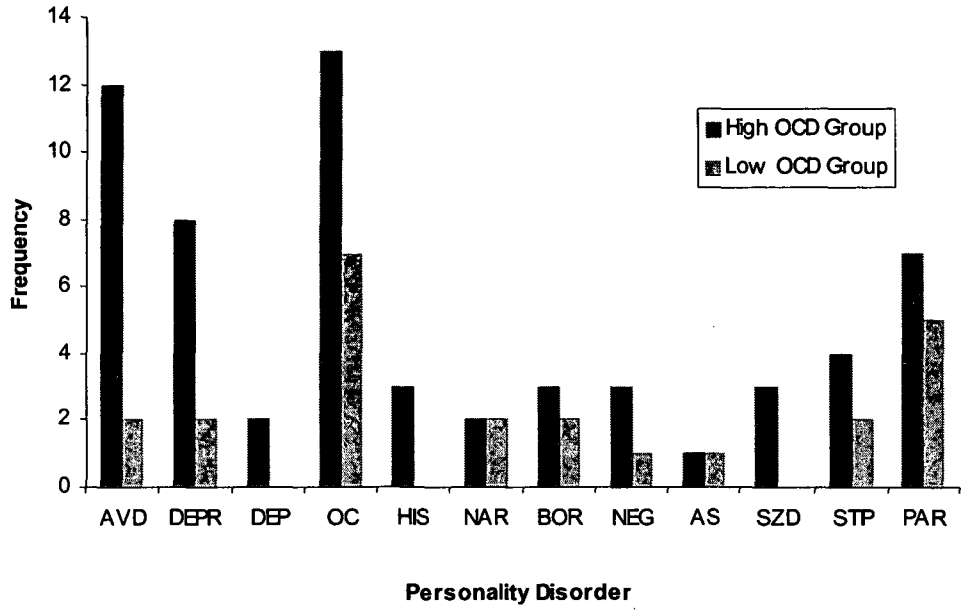


Figure 6. Frequency of PDQ-4+ personality disorder diagnosis for high and low OCD groups. (AVD; avoidant; DEPR, depressive; DEP, dependant; OC, obsessive-compulsive; HIS, histrionic; NAR, narcissistic; BOR, borderline; NEG, negativistic; AS, antisocial; SZD, schizoid; STP, schizotypal; and PAR, paranoid).

Personality and OCD Symptoms

A mixed factorial ANOVA examining the mean differences between the five NEO PI-R personality variables and OCPD on the PDQ-4+ for the high and low OCD groups revealed a significant main effect for personality $F_{(5,42)} = 72.43$, $MSE = 1.19$, $p < .001$ indicating that there were significant differences between scores on the personality measures. However, there was no significant interaction between OCD group and personality $F_{(5,42)} = .88$, $p = .49$, indicating that mean personality scores did not differ significantly between the two OCD symptom groups as can be seen in Table 2.

Table 2

Mean (Standard Deviation) [Range] of personality variables for high and low OCD symptom groups. (N, neuroticism; E, extroversion; O, openness; A, agreeableness; C, conscientiousness; OCPD, symptoms of obsessive-compulsive PD).

	High OCD Group (n = 23)			Low OCD Group (n = 21)		
N	.97	(1.25)	[-.97 – 3.87]	.54	(.65)	[-1.02 – 1.79]
E	.54	(.84)	[-.99 – 2.05]	.37	(.89)	[-1.49 – 1.92]
O	.68	(.90)	[-1.05 – 2.97]	.85	(.93)	[-.75 – 2.45]
A	-.64	(1.58)	[-4.85 – 1.28]	-.58	(.89)	[-2.24 – 1.42
C	-.82	(1.10)	[-3.35 – 1.03]	-1.21	(1.04)	[-3.20 - .47]
OCPD	3.30	(1.22)	[1 – 5]	2.67	(1.59)	[0 – 5]

HCIs and OCD Symptoms

A mixed factorial ANOVA examining the mean differences in the four HCI scores (exposure, response prevention, ritualisation, and avoidance) between the two OCD symptom groups revealed a significant main effect for HCIs. This indicates that there were significant differences in scores between HCIs, $F_{(3,126)} = 84.06$, $MSE = 2282.20$, $p < .001$. There was no significant interaction between the OCD symptom groups and HCIs, $F_{(3,126)} = 1.79$, $p = .15$, indicating that scores on HCIs did not significantly differ between groups.

Table 3 includes the mean scores of the four HCIs specific to exposure and response prevention, as well as total moves and mouse travel. Although not statistically significant the HCIs of exposure, ritualisation, and avoidance were greater for the high OCD group, while enactments of response prevention was greater for the low OCD group. The total moves made by participants was similar across both OCD groups, however, higher scores on mouse travel for the high OCD group indicates

less decisiveness in their moves made. There is a large range of scores obtained for all HCIs as shown in Table 3.

Table 3

Mean (Standard Deviation) [Range] of HCIs for high and low OCD groups.

	High OCD Group (n = 23)			Low OCD Group (n = 21)		
Exposure	45.35	(31.01)	[8 – 107]	34.33	(17.57)	[4 – 64]
Response Prevention	141.09	(77.37)	[16 – 319]	170.38	(69.01)	[42 – 293]
Ritualisation	13.57	(9.44)	[1 – 36]	8.76	(6.30)	[0 – 22]
Avoidance	31.30	(41.08)	[0 – 150]	20.43	(31.00)	[0 – 119]
Total Moves	228.09	(54.66)	[48-341]	230.24	(42.78)	[140 – 319]
Mouse Travel	61×10^3	(16×10^3)	[21×10^3 – 86×10^3]	55×10^3	(12×10^3)	[36×10^3 – 85×10^3]

Figure 7 illustrates the percentage of participants in the high and low OCD groups undertaking each HCI set. This figure also includes the relative percentage of each of the four HCI sets as a function of all HCI occurrences. Participant's in the high OCD group undertook more than two times the occurrences of ritualisation and avoidance behaviours, and almost a third more exposure than the low OCD group. Both high and low groups had similar occurrences of response prevention, with this HCI making up the largest percentage of all behaviours, or HCIs, enacted in CAVE. The least frequently occurring behaviour for the entire sample was ritualisation.

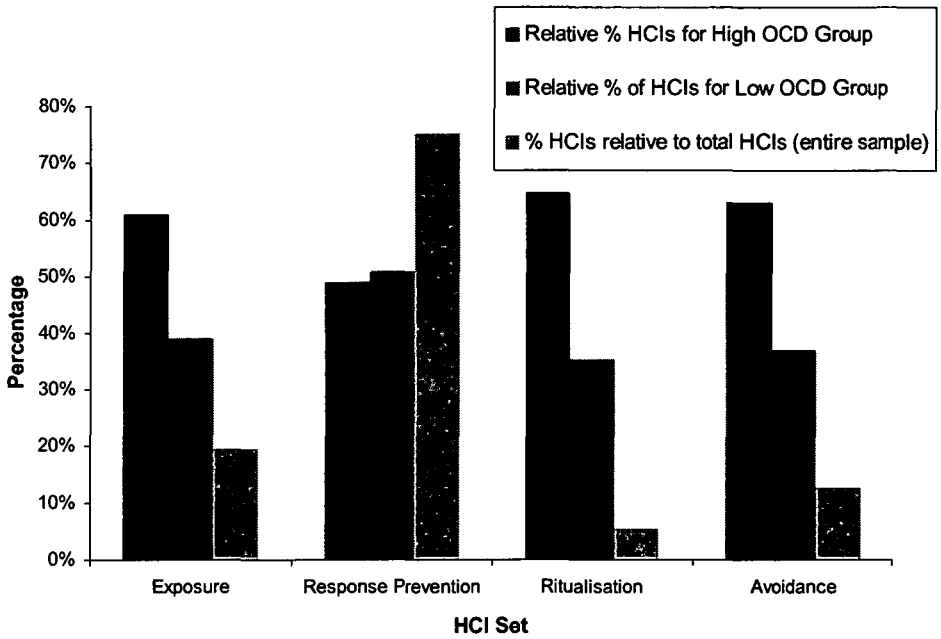


Figure 7. Relative percentage of HCI sets for high and low OCD groups, and percentage of HCI sets relative to total HCIs for the entire sample.

Personality and HCIs

Pearson correlational analyses were conducted between the six personality variables, four HCI sets, and total moves and mouse travel using the entire sample ($n = 44$). Table 4 presents the relationships between these variables. There was a significant, positive relationship between ritualisation and the personality variables of extroversion and conscientiousness. These results indicate that those with greater traits of extroversion or conscientiousness undertook relatively more behaviour related to handwashing or ritualisation. The significant positive correlation between neuroticism and mouse travel indicates that those with higher scores on neuroticism were less decisive in their computer mouse moves.

Table 4

Correlation coefficients for HCIs and personality variables for entire sample (n = 44). (N, neuroticism; E, extroversion; O, openness; A, agreeableness; C, conscientiousness; OCPD, symptoms of obsessive-compulsive PD).

	Personality Measures					
	N	**E**	**O**	**A**	**C**	**OCPD**
Exposure	.14	.14	-.08	.01	-.10	-.03
Response Prevention	.16	.01	-.03	.17	-.22	-.02
Ritualisation	-.15	.38*	.28	.15	.53**	.22
Avoidance	-.18	-.11	-.29	-.24	.14	.04
Total Moves	.17	.07	-.24	.11	-.19	.04
Mouse Travel	.31*	-.15	-.14	-.14	-.06	.06

* $p < .05$, ** $p < .01$

Personality and HCIs for High OCD Group

Pearson correlational analyses examining the relationship between the six personality variables and four HCIs among participants in the high OCD group are shown in Table 5. As Table 5 shows, there was a significant positive relationship between conscientiousness and ritualisation. These findings indicate that those with higher conscientious scores undertook relatively more ritualising, that is more hand washing behaviour. There was also a significant positive relationship between OCPD symptoms and total moves, indicating that those with more OCPD symptoms undertook more computer-mouse clicking activity.

Table 5

Correlation coefficients for HCIs and personality variables for the high OCD group (n = 23). (N, neuroticism; E, extroversion; O, openness; A, agreeableness; C, conscientiousness; OCPD, symptoms of obsessive-compulsive PD).

	Personality Measures					
	N	**E**	**O**	**A**	**C**	**OCPD**
Exposure	.18	.14	-.13	.06	-.28	-.21
Response Prevention	.18	.01	.12	.21	-.26	.37
Ritualisation	-.23	.40	.37	.28	.50*	.14
Avoidance	-.20	.05	-.35	-.34	.31	.10
Total Moves	.18	.20	-.10	.12	-.21	.51*
Mouse Travel	.18	.20	-.10	.12	-.21	.24

* $p < .05$

Personality and HCIs for Low OCD Group

The results of a Pearson correlation analysis examining personality and HCIs for the low OCD group are presented in Table 6. There was a significant positive relationship between conscientiousness and ritualisation. This finding indicates that those with higher conscientious traits undertook relatively more ritualisation behaviours on CAVE. A significant negative relationship between openness and the HCIs of total moves and mouse travel was present. This indicates that those with more openness traits performed less computer mouse clicking, and were more decisive in their moves. Likewise, a significant negative relationship between OCPD symptoms and total moves indicates that those with more OCPD symptoms undertook less mouse clicking activity.

Table 6

Correlation coefficients for HCIs and personality variables for the low OCD group (n = 21). (N, neuroticism; E, extroversion; O, openness; A, agreeableness; C, conscientiousness; OCPD, symptoms of obsessive-compulsive PD).

	Personality Measures					
	N	**E**	**O**	**A**	**C**	**OCPD**
Exposure	-.20	.12	.07	-.15	.12	.10
Response Prevention	.33	.05	-.24	.10	-.09	-.30
Ritualisation	-.25	.35	.27	-.17	.53*	.22
Avoidance	-.30	-.36	-.18	.02	-.18	-.10
Total Moves	-.19	-.09	-.43*	-.08	-.14	-.45*
Mouse Travel	.19	-.09	-.43*	.08	-.14	-.24

* $p < .05$

Discussion

The aim of this present study was to examine the relationship between FFM personality variables, symptoms of OCPD, and HCIs in a single session of CAVE for OCD, in a non-clinical sample with high and low OCD symptoms. Each of the hypotheses related to this aim will be examined in turn.

OCD Symptoms

The results of this study confirm that the spectrum of OCD symptoms is not limited to clinical populations. Indeed, in this study a non-clinical Australian university student sample experienced symptoms common to OCD. These findings support the earlier work of Rachman and De Silva (1978) who found that OCD symptoms are common in the general population. The experience of OCD symptoms in a non-clinical student sample in the present study is consistent with recent studies also using non-clinical student samples (see Rosen & Tallis, 1995; Scarrabelotti et al., 1995).

The two OCD groups in this study were selected on the basis of their OCD symptomatology and as such significantly differed in the degree of OCD symptom presence and disturbance caused by these symptoms. Specifically, the high OCD group experienced more symptoms related to thoughts of harm, impulses to harm, contamination obsessions and washing compulsions, checking behaviours, and dressing or grooming compulsions. The two OCD groups examined can be likened to a non-clinical (low OCD group) and subclinical (high OCD group) group. The most common symptoms experienced by both groups were checking compulsions, followed by contamination obsessions and washing compulsions. This pattern of symptom expression is congruent with the findings in the literature (Freeman, 1992; Rasmussen & Eisen, 1992).

Personality

The first hypothesis suggested that scores on neuroticism and symptoms of OCPD would be significantly greater for the high OCD group. Although the mean scores on these two personality measures were higher for the high OCD group, they were not significantly different from the low OCD group. Therefore the first hypothesis was not supported. The lack of a definitive relationship between OCD and OCPD is consistent with the literature (see Black & Noyes, 1997). It is surprising, however, that neuroticism was not associated with OCD symptoms, as previous research indicates that neuroticism underlies anxiety disorders such as OCD (Clark, Watson, & Mineka, 1994; Pollack, 1987; Watson, Clark, & Harkness, 1994), and is also associated with OCPD (Widiger, Trull, Clarkin, Sanderson, & Costa, 1994). However, the sample in the present study was a non-clinical sample. This suggests that there may be differences in neuroticism traits between those with a clinical diagnosis of OCD compared with those experiencing non- or sub-clinical OCD symptoms. For example, certain levels of neuroticism may be a precursor to developing a clinical disorder or alternatively a clinical disorder may influence personality characteristics.

Five Factor Model Traits

There were no significant differences between any of the FFM personality traits between the high and low OCD groups. It is noteworthy that all scores were within

one standard deviation of mean NEO PI-R normative scores, with the exception of the mean conscientiousness score for the low OCD group, which was less than one standard deviation below the mean normative data. Indeed, conscientiousness traits were below average for both high and low OCD groups. This is surprising as it would be expected that a student sample would have a higher degree of conscientious traits, given the nature of their role, as conscientiousness is juxtaposed with academic achievement (Costa & McCrae, 1994). It is not clear why this result occurred; there may be cultural differences between an American normative group and an Australian sample that influence conscientiousness traits, or first year undergraduate students may have different conscientiousness scores compared to those further along their academic career.

Personality Disorders

Upon examination of categorical personality measures, approximately one third of the sample met the diagnostic criteria for a PD. The present study had a lower rate of PD diagnosis on the PDQ-4+ compared to Rosen and Tallis (1995), who used the earlier PDQ-R and found approximately two-thirds of their English student sample had a PD diagnosis. This difference in PD diagnosis may be attributed to several factors, such as the version of the PDQ used or cultural differences between an English and Australian student sample impacting PD diagnosis. However, it has been noted that the PDQ-4+, like its predecessors, elicits a high number of false positive diagnoses (Hyler & Loh, 1998), therefore the PD results of the present study may have been overestimated and should be interpreted with caution.

PD symptom endorsement did not significantly differ between the two OCD groups, rather there were trends in PD diagnosis and symptoms common to both groups. The most common PD diagnosis and symptom endorsement for both OCD groups was for OCPD, followed by other PDs from Cluster C. This is surprising as the sample obtained below average conscientiousness scores, which is a feature of OCPD. However, the predominance of Cluster C PDs, characterised by anxiety, may be explained in part by the above average neuroticism scores the high and low OCD groups obtained, as neuroticism is associated with anxiety.

These findings suggest that there is not an exclusive relationship between OCD and OCPD, supporting a majority of the literature investigating OCD and OCPD (Black & Russell, 1997; Mavissakalian, Hamman, & Jones 1990a, 1990b). Instead, irrespective of OCD symptomatology it appears that the presence of PD symptoms, in particular anxiety-related PDs, is not unusual and is consistent with the scores on the dimensional personality measure of neuroticism.

Human Computer Interactions (HCIs)

The second hypothesis, that those with fewer OCD symptoms would have a higher degree of vicarious exposure interaction with the CAVE program, was not supported as there were no significant differences in any of the HCIs measured between those with subclinical or non-clinical OCD symptoms. This contrasts the findings of Clark, Kirkby, Daniels, and Marks (1998), who found that participants with OCD conducted less exposure in their first session of CAVE, compared to non-clinical controls.

The contradictory findings between the present study and the findings of Clark et al. (1998) may be attributed to several factors. First, differences may be a reflection of dissimilar samples as the present study used a sample not diagnosed with OCD. There may be fundamental differences between a clinical and analogue non-clinical sample impacting behaviour that are beyond the scope of this study. Second, the predominant OCD symptoms for both groups in the present study related to checking. Clark et al. noted that the efficacy of CAVE as a treatment was not as high for those with primarily checking OCD symptoms as it was for those with contamination obsessions and washing rituals, as depicted in the program. Although this present research was not a treatment study, as shown by Clark et al., the program may not be as relevant to those who do not have the same contamination related obsessions or compulsions as presented on CAVE. This may minimise identification with the on-screen figure and subsequent vicarious exposure and response prevention activity. Third, there was a wide range in HCI set scores obtained by participants in the high and low OCD groups which may have impacted subsequent statistical analyses.

Examination of the relative percentage of each of the four HCI sets as a function of all HCI occurrences revealed that for both OCD groups combined, the desired behaviour of response prevention was conducted most often, and ritualisation least often. This suggests that participant's in the present study understood the purpose of the program presented on-screen and therefore the principles of exposure and response prevention.

HCIs and Personality

Further analysis of participant's behaviour on CAVE, examining the effects of personality, yielded results contrary to the third hypothesis. It was posited that low scores on neuroticism and high scores on extroversion, openness, agreeableness, and conscientiousness would be associated with more exposure activity. There were no significant relationships between these personality variables and behaviour associated with exposure.

When the entire sample was considered, irrespective of the level of OCD symptoms experienced, conscientiousness and extroversion were independently associated with more ritualisation. That is, hand washing behaviour and neuroticism were associated with more mouse travel or indecisive behaviour. Higher rates of hand washing in conscientious individuals may be an expression or indication of their fastidious behaviour. For example examining all aspects of the program or undertaking all facets of behaviour available on CAVE.

With respect to extroversion, the activity of hand washing shows active involvement in the program (although contrary to the aim of CAVE), and may be perceived as part of the stimulation-seeking characteristics of those with extroverted characteristics. However, this does not address the anxiety-reducing capacity hand washing has. Handwashing reduces anxiety in the program, and those with higher extroversion scores, by definition, are less susceptible to experiencing anxiety or distress. It is likely that more ritualisation in those with extroverted characteristics is a reflection of expressiveness within treatment as suggested by Miller (1991), as extroversion is not a trait previously found to be associated with behaviours such as ritualisation that contradict the aim of behaviour therapy.

The finding that those with more neuroticism traits undertook more mouse travel, a measure of indecision, is consistent with the neuroticism factor. The distress experienced by those with higher neuroticism traits may impede their decision-making. Alternatively the process of decision making may cause distress in those with higher neuroticism traits, further compounding difficulties in decision-making. As a result of anxiety and stress, indecision may follow with various options being tried before committing to an action. This finding has not been noted in the earlier CAVE study using a sample diagnosed with agoraphobia (Harcourt, Kirkby, Daniels, & Montgomery, 1998).

HCIs, Personality, and Level of OCD Symptoms

The HCI and personality data were further analysed taking into account the level of OCD symptoms. With the group experiencing subclinical OCD symptoms (high OCD group), the pattern of conscientiousness being associated with ritualisation was repeated. The fastidiousness of those with higher conscientiousness scores may have been further compounded by the anxiety caused by the OCD symptoms, or perhaps personal identification with the on screen character, leading to greater hand washing.

Symptoms of OCPD were associated with a higher level of mouse clicking activity. It could be that those with subclinical anxiety-provoking OCD symptoms with high OCPD traits may use their pedantic and obsessive style to explore their environment to ensure they know what is available and the capabilities of the program. Such knowledge may then reduce any anxiety caused by unfamiliarity with CAVE.

The relationship between personality and HCIs exclusive of the effect of OCD symptoms was examined using only those experiencing a non-clinical level of OCD symptoms (low OCD group). Theoretically, behaviours in this group would not be clouded by anxiety as a consequence of OCD symptoms. With this group, the pattern of conscientiousness associated with ritualisation behaviours was again repeated. This indicates that regardless of OCD symptomatology, those with more conscientious traits undertook more ritualisation on CAVE.

Members of the low OCD group obtaining low scores on OCPD symptoms (fewer rigid or perfectionist traits) tended to undertake more mouse clicking behaviour. This is in contrast to the high OCD group; those with higher scores on OCPD undertook more mouse clicking. Of the studies examining participant's interaction with behaviour therapy for OCD, PD variables have not been previously examined. It appears that the presence of different levels of OCD symptomatology with OCPD symptoms can impact user activity in CAVE. For example, higher OCD symptoms combined with higher OCPD symptoms may exacerbate obsessive behaviour, such as mouse clicking in only one area of the program, or pedantic mouse clicking in many areas of the program. The higher mouse clicking behaviour of those with few OCD and OCPD symptoms may be interpreted as 'exploratory' in the absence of high obsessive traits. Conclusive results cannot be drawn however, as correlational relationships do not indicate causality.

Unexpectedly, low scores on openness were associated with more mouse clicking activity and mouse travel. This suggests that those who are less open to experience and adopt a conventional or conservative outlook undertook more activity in CAVE, yet displayed indecisiveness in their moves. Kirkby, Daniels, Harcourt, and Romano (1999) found that openness was associated with less exposure and more exploration in CAVE, however they used a sample of agoraphobia sufferers who may have different personality traits than those with OCD symptoms.

Although the hypotheses were not supported, some interesting and unexpected modest relationships emerged, indicating that information on personality features can provide further understanding into how people interact with a CAVE program for OCD. First, it is clear that OCD symptoms are not unique to clinical groups, and are experienced by non-clinical student samples. Second, although the PDQ-4+ is known to overestimate PDs, there was still a high rate of PD characteristics (predominantly from Cluster C) in this student sample, irrespective of OCD symptomatology. Third, participants undertook the desired behaviours of exposure and response prevention in CAVE for OCD. Fourth, conscientiousness was the only personality variable consistently associated with ritualisation behaviours irrespective of OCD symptomatology. Finally the overall level of mouse clicking activity in CAVE in

those with symptoms of OCPD differed according to the presence or absence of OCD symptoms.

Methodological Issues, Limitations and Future Research

OCD Symptoms

The two groups formed on the basis of PI-R scores were not equivalent to comparing a non-clinical with a clinical sample. Marked personality and HCI differences may be present in a clinical OCD sample, particularly a sample with predominating contamination obsessions and washing rituals that were not present in this study. Likewise, the experience of a clinical disorder may be fundamentally different to the experience of non- or sub-clinical OCD symptoms, which may subsequently influence behaviour on CAVE.

Personality and HCIs

It has been noted that the study of personality may be contaminated by the presence of anxiety or depressive symptoms (Rosen & Tallis, 1995). This study used a student sample, screened for OCD and depressive symptoms, aiming to eliminate confounding caused by depression. However, the use of a general screening measure for anxiety traits and symptoms of other anxiety disorders may have assisted in obtaining a more 'pure' sample for comparison purposes.

Further research to clarify if the present high rate of PD characteristics was a result of overestimation of the PDQ-4+ or an accurate reflection of participant characteristics could be done by using a combination of assessment measures such as self-rated and assessor-rated measures. The presence of a high rate of PD diagnosis in the sample may have impacted findings. As demonstrated, different dimensional personality traits have different relationships with HCIs. As PDs tend to be pervasive their presence may have further influenced participant's behaviour on CAVE.

Sample

The sample size, though adequate for the analyses conducted, was small. A larger sample size would increase the power of the study ensuring that significant effects were not random and non-significant effects repressed due to sample size limitations. The large variations in the present scores (e.g., in HCI scores) may be minimised with a larger sample by reducing the effect of individual variations. The sample was also drawn from a psychology student population, which is not representative of the population at large. Thus comparisons using a non-clinical and clinical random sample of the general population would provide a more accurate picture of the interaction between personality, HCIs and OCD symptoms, in particular assessing these variables using CAVE as a treatment for those with OCD.

Conclusion

Individual personality characteristics impact upon the way in which people interact with a therapy program. This study supports the notion that computers can be a useful tool in the collection of real time data. Such data can provide valuable information regarding the way in which people engage with behaviour therapy, which may not be otherwise available in traditional therapist-client relationships. Ultimately, this information can be used to determine the features of therapy that are most useful for making treatment gains for people with different characteristics, enabling effective treatments to be tailored to meet the needs of clients.

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Appendix A – Personal Data Sheet

Personal Data Sheet

HB00OCD

Personality, Obsessive-Compulsive Disorder Symptoms & Human Computer Interactions

Date ___/___/___ *ID Number:* ***00HB***_ _ _

*Name*_____ *Sex:* ***(Please circle)*** ***M/F***

Address _____

_____ *Postcode*_____

Phone: **Home** _____ **Work** _____ **Other** _____

Email address _____

Date of birth ___/___/___ *Your current age:* ***Years*** ___ ***Months*** ___

Your University Course _____

Occupation (if any) _____

Are you currently taking any medication? ***(Please circle)*** ***Yes*** ***No***

If yes, *please specify your condition(s) and corresponding medication(s):*

_____

_____

Do you have a heart condition, or any other serious medical condition(s)?

If yes, please specify: _____

Do you currently have, or have you ever had a psychological condition?
(Please circle) ***Yes*** ***No***

If yes, *please specify your condition(s) and please list any corresponding treatment.*

Current _____

Previous _____

Please indicate the level of your previous experience with using a computer mouse by circling the appropriate number below:

1 2 3 4 5 6 7 8 9 10

|——————————————————————————————————————|

NONE ***MODERATE*** ***A LOT***

Would you be interested in being contacted for any follow-up studies?
Please circle: Yes ***No***

If yes, *please provide the following information to assist us in getting in touch with you:*

Next of Kin _____ *Relationship to you* _____

Address _____

_____ *Postcode* _____

Do you wish to be sent a summary of the results of this study?

Please circle: ***Yes*** ***No***

Appendix B – Participant Information Sheet

UNIVERSITY OF TASMANIA

Participant Information Sheet

Personality, Obsessive-Compulsive Disorder Symptoms and Human Computer Interactions

Chief Investigators : Professor Kenneth Kirkby and Dr Frances Martin
Researcher : Harjit Bagga

Purpose of the Study: This study has been designed to explore the relationship between obsessive-compulsive disorder symptoms, personality traits, and how people interact with a computer program that simulates treatment for Obsessive Compulsive Disorder. This project is being undertaken as part of the requirements for the researcher's Master of Psychology degree.

You have already completed a questionnaire on common worries and concerns that most people experience sometime in their life. To be involved in the remainder of the study, you need to be able to use a standard computer, and not be taking any psychotropic medication. If you decide to participate in this study, you will be presented with (1) a questionnaire on a computer that will look at some of the worries and concerns that you may have had, and (2) pencil and paper questionnaires that look at common personality characteristics. You will then use an interactive computer program for 45 minutes, where you will control the actions of an on-screen character, to determine their movements around a house, garden and suburb. The time commitment for your involvement will be approximately 1 ½ - 2 hours.

Being asked about your worries and concerns may or may not be unpleasant. Some feelings you might have are fearful or worrying thoughts. You may experience some of these symptoms during this study. Assistance will be available to you to deal with these symptoms if they trouble you. There is no payment for this study and participation is entirely voluntary. You are free to withdraw from the study at any time, without academic penalty.

The information you give us will be kept confidential. Only the researchers conducting the investigation will have access to the identifying data, which will be kept in a locked filing cabinet at the University. The results of the study may be published in journal articles but individual identifying data will not be published. You may have access to the group results of the investigation on request.

This project has been approved by the University of Tasmania Ethics Committee. If you have any ethical concerns or complaints about the manner in which this project is being conducted, you may contact members of the University Human Research Ethics Committee:

Chair: Dr Margaret Otlowski (03) 6226 7569 Secretary: Ms Chris Hooper (03) 6222 8160

If require further information at any stage please contact Harjit Bagga during business hours on (03) 6226 4885. You may also contact Professor Kirkby during business hours on (03) 6226 4885 or after hours on (03) 6228 2971.

You will be given copies of the information sheet and consent form to keep.

Thank you for your time and assistance.

Appendix C – Participant Consent Form

UNIVERSITY OF TASMANIA

Participant Consent Form

Personality, Obsessive-Compulsive Disorder Symptoms and Human Computer Interactions

1. I have read and understood the Information Sheet for this study.
2. The nature and possible effects of the study have been explained to me.
3. I understand that the study involves the following procedures:

- Completing questionnaires
- Using a computer program simulating treatment for Obsessive-Compulsive Disorder

4. I understand that I may experience mental or physical symptoms of anxiety.
5. Any questions that I have asked have been answered to my satisfaction.
6. I understand that all research data will be treated as confidential.
7. I agree that research data gathered for the study may be published provided that I cannot be identified as a participant.
8. I agree to participate in this investigation and understand that I may withdraw at any time without penalty.

Name of Participant.....

Signature.....

Date.....

Researcher Section :

I have explained this study and the implications of participation to this participant. I believe that the consent is informed and that they understand the implications of participation.

Name of Researcher.....

Signature.....

Date.....

Appendix D: Screening for Normality – Skewness & Kurtosis

	Skewness		Kurtosis	
	Statistic	Standard Error	Statistic	Standard Error
Neuroticism	.79	.36	1.75	.70
Extroversion	-.34	.36	-.48	.70
Openness	.34	.36	-.20	.70
Agreeableness	-.90	.36	1.56	.70
Conscientiousness	-.32	.36	-.63	.70
OCPD	-.40	.36	-.83	.70
Exposure	1.01	.36	1.25	.70
Response Prevention	.23	.36	-.15	.70
Ritualisation	.91	.36	1.01	.70
Avoidance*	1.73	.36	2.40	.70

* Violation of assumption of normality

Appendix E: Screening for Homogeneity of Variance

Variable	Levene's Test of Homogeneity of Equality of Error Variances			
	F	df1	df2	Significance
Neuroticism*	5.82	1	42	.02
Extroversion	.09	1	42	.77
Openness	.26	1	42	.61
Agreeableness*	5.85	1	42	.02
Conscientiousness	.09	1	42	.76
OCPD	1.80	1	42	.19
Exposure*	8.60	1	42	.01
Response Prevention	.08	1	42	.78
Ritualisation	3.70	1	42	.06
Avoidance	3.12	1	42	.09

* Violation of homogeneity of variance, $p < .05$

Appendix F: Spearman's Correlation between Sex and Dependent Variables

DV	Spearman's rho
Neuroticism	-.02
Extroversion	-.04
Openness	-.08
Agreeableness	-.12
Conscientiousness	-.42**
OCPD	.07
Exposure	-.31*
Response Prevention	.18
Ritualisation	-.25
Avoidance	.10

* $p < .05$, ** $p < .01$

Appendix G: Pearson Correlations between Age and Estimated FSIQ, and Dependent Variables

	Age	FSIQ
Neuroticism	-.21	.17
Extroversion	-.49**	-.15
Openness	-.01	.13
Agreeableness	.09	.09
Conscientiousness	-.11	-.16
OCPD	-.09	-.07
Exposure	-.07	.05
Response Prevention	-.18	-.10
Ritualisation	-.20	-.10
Avoidance	.23	-.01

** $p < .01$

Appendix H: Post Hoc Tests for PI-R Content Dimensions.

PI-R Content Dimension	Fisher's Protected LSD Effect		
	Difference	Critical Difference	*p* value
Thoughts of Harm	4.57	1.87	<.001
Impulses to Harm	1.91	1.69	.027
Contamination/ Washing	10.10	3.00	<.001
Checking	13.04	2.75	<.001
Dressing	2.94	1.35	<.001